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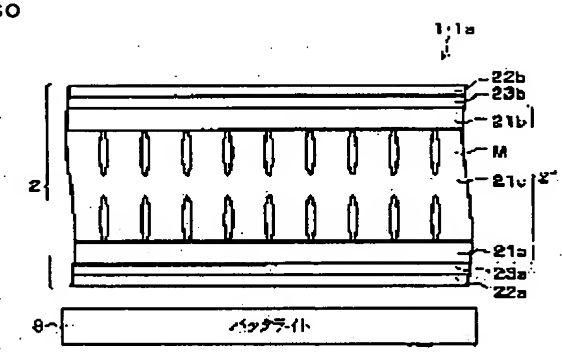
(54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To realize a liquid crystal display device in which alignment disorder does not have an influence on display and display quality is hardly decreased even when alignment directions of liquid crystal molecules are controlled so as to be different from one another in pixels.
SOLUTION: In the liquid crystal display device 1, circularly polarized light passed through a λ/4 plate 23a is made incident to a liquid crystal layer 21 exhibiting radial tilt alignment in which the alignment direction changes continuously when voltage is applied. As a result, the liquid crystal molecules can contribute to the display as far as the alignment direction and the visual angle of the liquid crystal molecules are not coincident with each other not only about an in-plane component but also about a substrate normal component even if the alignment state of the liquid crystal molecules is disordered. Thus as a result of using the liquid crystal layer in which the alignment directions of the liquid crystal molecules are controlled so as to be different from one another in the pixel for securing a wide visual field angle, the liquid crystal display device 1 having high display quality without roughness can be realized, even though not only the edge region of a pixel electrode but also the boundary region of domains exist.



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CLAIMS

[Claim(s)]
[Claim 1] The 1st substrate with which the pixel electrode corresponding to a pixel was prepared, and the 2nd substrate with which the counterelectrode was prepared, The liquid crystal layer controlled so that the directions of orientation of a liquid crystal molecule differ mutually in a pixel in the case of the value as which it is prepared among both the substrates concerned, and the electrical potential difference between the above-mentioned pixel electrode and a counterelectrode is determined beforehand at least, The analyzer arranged on the outgoing radiation side of the above-mentioned liquid crystal layer, and a circular polarization of light means to set the incident light to the above-mentioned liquid crystal layer as an approximate circle polarization condition, The liquid crystal display with which it is prepared between the above-mentioned liquid crystal layer and an analyzer, and retardation of field inboard is characterized by having the 1st phase contrast layer set as the abbreviation quadrant wavelength of the wavelength of the transmitted light.
[Claim 2] The 1st substrate with which the pixel electrode corresponding to a pixel was prepared, and the 2nd substrate with which the counterelectrode was prepared, The liquid crystal layer to which the direction of orientation of a liquid crystal molecule presents the radial inclination orientation which changes continuously in the case of the value as which it is prepared among both the substrates concerned, and the electrical potential difference between the above-mentioned pixel electrode and a counterelectrode is determined beforehand at least, The analyzer arranged on the outgoing radiation side of the above-mentioned liquid crystal layer, and a circular polarization of light means to set the incident light to the above-mentioned liquid crystal layer as an approximate circle polarization condition, The liquid crystal display with which it is prepared between the above-mentioned liquid crystal layer and an analyzer, and retardation of field inboard is characterized by having the 1st phase contrast layer set as the abbreviation quadrant wavelength of the wavelength of the transmitted light.
[Claim 3] The 1st substrate with which the pixel electrode corresponding to a pixel was prepared, and the 2nd substrate with which the counterelectrode was prepared, The liquid crystal layer in which the direction of orientation of a liquid crystal molecule carries out multi-domain orientation in the case of the value as which it is prepared among both the substrates concerned, and the electrical potential difference between the above-mentioned pixel electrode and a counterelectrode is determined beforehand at least, The analyzer arranged on the outgoing radiation side of the above-mentioned liquid crystal layer, and a circular polarization of light means to set the incident light to the above-mentioned liquid crystal layer as an approximate circle polarization condition, The liquid crystal display with which it is prepared between the above-mentioned liquid crystal layer and an analyzer, and retardation of field inboard is characterized by having the 1st phase contrast layer set as the abbreviation quadrant wavelength of the wavelength of the transmitted light.
[Claim 4] It is the liquid crystal display according to claim 1, 2, or 3 with which the above-mentioned 1st phase contrast layer is characterized by setting the retardation of field inboard as a 550nm abbreviation quadrant while the above-mentioned circular polarization of light means sets light with a wavelength of 550nm as an approximate circle polarization condition.
[Claim 5] The above-mentioned retardation is a liquid crystal display according to claim 4 characterized by being set as 95nm or more and 175nm or less.
[Claim 6] The above-mentioned circular polarization of light means is a liquid crystal display according to claim 1, 2, 3, 4, or 5 characterized by being the selective reflection layer which reflects the circular polarization of light which circles to hard flow while making the circular polarization of light of the revolution direction which it is prepared in the incidence side of the above-mentioned liquid crystal layer,

and is defined beforehand penetrate.
[Claim 7] The above-mentioned circular polarization of light means is a liquid crystal display according to claim 1, 2, 3, 4, or 5 with which it is allotted between the polarizer prepared in the incidence side of the above-mentioned liquid crystal layer, the polarizer concerned, and a liquid crystal layer, and retardation of field inboard is characterized by having the 2nd phase contrast layer set as the abbreviation quadrant wavelength of the wavelength of the transmitted light.
[Claim 8] The above-mentioned analyzer is arranged on one side of the above-mentioned liquid crystal layer. The above-mentioned polarizer While being allotted to another side, the include angle the transparency shaft of the above-mentioned analyzer and whose lagging axis of the 1st phase contrast layer are 45 degrees so that nothing and the include angle the transparency shaft of the above-mentioned polarizer and whose lagging axis of the 2nd phase contrast layer are 45 degrees may moreover be made The liquid crystal display according to claim 7 characterized by allotting the 1st and 2nd phase contrast layer to the above-mentioned analyzer and the polarizer list.
[Claim 9] It is the liquid crystal display according to claim 7 characterized by allotting the above-mentioned 1st and 2nd phase contrast layer so that each lagging axis may intersect perpendicularly mutually, and arranging the above-mentioned analyzer and the polarizer so that each transparency shaft may intersect perpendicularly mutually while the above-mentioned analyzer is arranged on one side of the above-mentioned liquid crystal layer and the above-mentioned polarizer is arranged on another side.
[Claim 10] The liquid crystal display according to claim 1, 2, 3, 4, 5, 6, 7, 8, or 9 characterized by having the viewing-angle compensation layer to which the refractive-index anisotropy was set so that it may be prepared in from the above-mentioned analyzer before a polarizer and the phase contrast changed among the phase contrast which the above-mentioned liquid crystal layer gives according to whenever [from / of the 1st substrate of the above / a normal to a viewing angle / tilt-angle] may be negated.

[Translation done.]

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention controls ZARATSUKI which originates in turbulence of an orientation condition etc. especially about the liquid crystal display controlled so that the directions of orientation of a liquid crystal molecule, such as for example, radial inclination orientation and multi-domain orientation, differed mutually in a pixel, and relates to the liquid crystal display which can improve display grace.
[0002]
[Description of the Prior Art] For example, for the optical anisotropy of liquid crystal, compared with displays, such as CRT, an angle of visibility tends to be narrow and the display grace at the time of seeing from across tends to fall in the liquid crystal display used as the display screens, such as a notebook computer and a word processor. The so-called multi-domain method which follows, for example, forms two or more fields in the direction of orientation of liquid crystal in JP,11-258605,A or JP,11-109391,A is proposed.
[0003] As an example of the liquid crystal display of a multi-domain method, with the perpendicular orientation film and the liquid crystal display in perpendicular orientation mode using liquid crystal with a negative dielectric anisotropy, if the configuration formed into the multi-domain is explained, in the state of no electrical-potential-difference impressing, the liquid crystal molecule is carrying out orientation perpendicularly. If incidence of the linearly polarized light is carried out to the liquid crystal layer of this condition from a polarizing plate, since a liquid crystal layer has almost no birefringence anisotropy, outgoing radiation of the linearly polarized light [having maintained the polarization condition] is carried out, and it is absorbed with the polarizing plate arranged on the opposite side of a liquid crystal layer. Consequently, a liquid crystal display indicates by black.
[0004] Contrary to this, if an electrical potential difference is impressed, as shown in drawing 18 R> 8, by liquid crystal layer 121c of a liquid crystal display 101, the liquid crystal molecule M inclines according to applied voltage. In addition, in this drawing, the case of the radial inclination orientation where the direction of orientation of the liquid crystal molecule M changes continuously is shown, and even if it is in the same pixel, focusing on the medial axis A of a radial inclination, the direction of orientation of the liquid crystal molecule M is with one field A101 and the field A102 of another side, and differ mutually. In this condition, if incidence of the linearly polarized light is carried out from polarizing plate 122a to liquid crystal layer 121c, liquid crystal layer 121c can give phase contrast to the transmitted light, and can change the polarization condition of the transmitted light. Therefore, generally the outgoing radiation light from a liquid crystal cell 121 changes to elliptically polarized light.
[0005] If incidence of the elliptically polarized light concerned is carried out to polarizing plate 122b allotted to the outgoing radiation side of a liquid crystal cell 121, unlike the time of no electrical-potential-difference impressing, the quantity of light according to the phase contrast given by liquid crystal layer 121c will penetrate. Therefore, the electrical potential difference impressed to liquid crystal layer 121c is controlled, by adjusting the direction of orientation of the liquid crystal molecule M, the outgoing radiation quantity of light of a liquid crystal display 101 can be changed, and a gradation display is attained.
[0006] Here, in the above-mentioned liquid crystal display 101, since the directions of orientation of the liquid crystal molecule M differ mutually even if it is among 1 pixel, even if the outgoing radiation quantity of light of the light which penetrated a certain liquid crystal molecule M decreases by seeing from across, in other liquid crystal molecules M with which the direction of orientation differs from the liquid crystal molecule M concerned, the thing to which the outgoing radiation quantity of light is made to increase also

exists. Consequently, the fields in which the liquid crystal molecule M with which the directions of orientation differ mutually exists compensate each other optically, they improve the display grace at the time of seeing from across, and can expand an angle of visibility.
[0007]
[Problem(s) to be Solved by the Invention] However, like the liquid crystal display 101 of the above-mentioned configuration, if it is going to control the direction of orientation in a pixel separately, it will be easy to generate orientation turbulence. Orientation turbulence occurs also according to few factors which follow, for example, did not become a problem in the case of the single directions of orientation, such as external electric field from a source signal line, a gate signal line, etc. Here, if the part which orientation turbulence generated by orientation turbulence becomes dark, since orientation turbulence differs for every part and every pixel, ZARATSUKI is observed by display and the problem of reducing display grace is produced.
[0008] Moreover, under two polarizing plates, when being controlled so that the directions of orientation differ mutually compared with the case of single orientation, since bearing which surely quenches exists as shown in drawing 19 , the brightness of the whole pixel will also fall compared with the case where the permeability planned in all parts is maintained. Consequently, the efficiency for light utilization (effective numerical aperture) of a liquid crystal display will also fall.
[0009] Here, even if the resolution and the number of gradation of a liquid crystal display are improving every year and an area of 1 pixel becomes small, the liquid crystal display which can display more gradation is called for. However, if an effective numerical aperture falls by the above-mentioned orientation turbulence, the brightness at the time of a white display will fall, and improvement in the number of gradation will become difficult. In addition, although brightness can be improved if pixel area is expanded, improvement in resolution becomes difficult.
[0010] This invention is made in view of the above-mentioned trouble, even if the purpose is the case where it is controlled so that the directions of orientation of a liquid crystal molecule differ mutually in a pixel, orientation turbulence does not influence a display but it is to realize the liquid crystal display with which display grace cannot fall easily.
[0011]
[Means for Solving the Problem] The 1st substrate with which the pixel electrode corresponding to a pixel was prepared in order that the liquid crystal display concerning this invention might solve the above-mentioned technical problem, The liquid crystal layer controlled so that the directions of orientation of a liquid crystal molecule differ mutually in a pixel in the case of the value as which it is prepared between the 2nd substrate with which the counterelectrode was prepared, and both the substrates concerned, and the electrical potential difference between the above-mentioned pixel electrode and a counterelectrode is determined beforehand at least, The analyzer arranged on the outgoing radiation side of the above-mentioned liquid crystal layer, and a circular polarization of light means to set the incident light to the above-mentioned liquid crystal layer as an approximate circle polarization condition, It is prepared between the above-mentioned liquid crystal layer and an analyzer, and retardation of field inboard is characterized by having the 1st phase contrast layer set as the abbreviation quadrant wavelength of the wavelength of the transmitted light.
[0012] Moreover, in order that other liquid crystal displays concerning this invention may solve the above-mentioned technical problem The 1st substrate with which the pixel electrode corresponding to a pixel was prepared, and the 2nd substrate with which the counterelectrode was prepared, The liquid crystal layer to which the direction of orientation of a liquid crystal molecule presents the radial inclination orientation which changes continuously in the case of the value as which it is prepared among both the substrates concerned, and the electrical potential difference between the above-mentioned pixel electrode and a counterelectrode is determined beforehand at least, The analyzer arranged on the outgoing radiation side of the above-mentioned liquid crystal layer, and a circular polarization of light means to set the incident light to the above-mentioned liquid crystal layer as an approximate circle polarization condition, It is prepared between the above-mentioned liquid crystal layer and an analyzer, and retardation of field inboard is characterized by having the 1st phase contrast layer set as the abbreviation quadrant wavelength of the wavelength of the transmitted light.
[0013] Furthermore, other liquid crystal displays to the pan concerning this invention The analyzer arranged on the outgoing radiation side of the liquid crystal layer of multi-domain orientation, and the above-mentioned liquid crystal layer in order to solve the above-mentioned technical problem, It is prepared between a circular polarization of light means to set the incident light to the above-mentioned liquid crystal

layer as an approximate circle polarization condition, and the above-mentioned liquid crystal layer and an analyzer, and retardation of field inboard is characterized by having the 1st phase contrast layer set as the abbreviation quadrant wavelength of the wavelength of the transmitted light.
[0014] In addition, in the liquid crystal display of each above-mentioned configuration, an incidence [of a liquid crystal display] and outgoing radiation side may be an opposite direction like the liquid crystal display of a transparency mold, and an outgoing radiation and incidence side may be the same like the liquid crystal display of a reflective mold.
[0015] In the liquid crystal display of each above-mentioned configuration, after the phase contrast of quadrant wavelength is given, incidence of the light which incidence of the approximate circle polarization was carried out to the liquid crystal layer, and carried out outgoing radiation to it from the liquid crystal layer is carried out to an analyzer by the 1st phase contrast layer.
[0016] If the liquid crystal molecule of the above-mentioned liquid crystal layer is carrying out orientation in the direction of a substrate normal (perpendicular), a liquid crystal layer cannot give phase contrast to the transmitted light. Consequently, outgoing radiation of the transmitted light is carried out, with approximate circle polarization maintained. After the outgoing radiation light concerned is changed into the linearly polarized light in the 1st phase contrast layer, it is inputted into an analyzer and transparency is restricted. Consequently, a liquid crystal display indicates by black. On the other hand, when the electrical potential difference between pixel electrodes, such as an initial orientation condition at the time of electrical-potential-difference impression or no electrical-potential-difference impressing, and a counterelectrode is a predetermined electrical potential difference, it is controlled so that the directions of orientation of a liquid crystal molecule differ mutually in a pixel. In this condition, since a liquid crystal layer gives the phase contrast according to an orientation condition to the transmitted light, the circular polarization of light is changed into elliptically polarized light. Therefore, even if it penetrates the 1st phase contrast layer, it does not return to the linearly polarized light, but outgoing radiation of a part of outgoing radiation light of the 1st phase contrast layer is carried out from an analyzer. These results, according to applied voltage, the outgoing radiation quantity of light from an analyzer can be controlled, and a gradation display is attained.
[0017] Moreover, since the directions of orientation of a liquid crystal molecule differ mutually in the pixel, the fields in which a mutually different liquid crystal molecule of the direction of orientation exists can compensate each other optically. Consequently, the display grace at the time of seeing from across is improved, and an angle of visibility can be expanded.
[0018] Here, in the above-mentioned liquid crystal layer, for wide-field-of-view angle reservation, as a result of controlling to differ mutually in a pixel, turbulence of an orientation condition tends to generate the direction of orientation of a liquid crystal molecule. If in the case of the conventional liquid crystal display with which incidence of the linearly polarized light is carried out to a liquid crystal layer, and incidence of the outgoing radiation light of a liquid crystal layer is carried out to an analyzer turbulence occurs in the orientation of a liquid crystal molecule and the component within a field of the direction of orientation is in agreement with the absorption shaft of an analyzer, it will become impossible therefore, for the liquid crystal molecule concerned to give phase contrast to the transmitted light irrespective of the direction component of a substrate normal. Here, since pixels differ, and how to confuse an orientation condition changes with locations even if it is in the same pixel, ZARATSUKI will occur. Moreover, since the liquid crystal molecule whose component within a field of the direction of orientation corresponded with the absorption shaft of an analyzer cannot contribute to the improvement in brightness, efficiency for light utilization (effective numerical aperture) falls. These results, reservation of a contrast ratio will become difficult and the increment in the number of gradation will also become difficult.
[0019] On the other hand, in the liquid crystal display concerning this invention, since incidence of the approximate circle polarization is carried out to a liquid crystal layer, unless the anisotropy about the direction of orientation of a liquid crystal layer is lost and the direction of orientation and the transmitted light of a liquid crystal molecule are in agreement on the both sides of the component within a field, and the direction of a substrate normal, a liquid crystal molecule can give phase contrast to the transmitted light. Therefore, for wide-field-of-view angle reservation, the direction of orientation of a liquid crystal molecule can be contributed to the improvement in brightness, unless the direction of orientation of the liquid crystal molecule with which orientation was in disorder is in agreement with a viewing angle, in spite of being easy to generate turbulence of an orientation condition, as a result of controlling to differ mutually in a pixel. Consequently, maintaining a large angle of visibility, high efficiency for light utilization can be secured and improvement in a contrast ratio and the increment in the number of gradation can be realized.
[0020] Moreover, as for the above-mentioned 1st phase contrast layer, it is more desirable to set the

retardation of field inboard as the 550nm abbreviation quadrant, while the above-mentioned circular polarization of light means sets light with a wavelength of 550nm as an approximate circle polarization condition in addition to the above-mentioned configuration.
[0021] With the configuration concerned, incidence of the approximate circle polarization is carried out about the wavelength which is 550nm with human being's highest visibility, and a brightness fall and generating of ZARATSUKI can be prevented about the light of the wavelength concerned. Consequently, the liquid crystal display with which neither a brightness fall nor ZARATSUKI can check approximate circle polarization by looking easily only on other wavelength compared with the case where incidence is carried out is realizable.
[0022] In addition, what is necessary is just to be able to carry out incidence of the approximate circle polarization to extent in which neither the above-mentioned brightness fall nor generating of ZARATSUKI is conspicuous, although what is necessary is for the above-mentioned circular polarization of light means just to be able to carry out incidence of the circular polarization of light. Moreover, although the retardation of the 1st phase contrast layer should also be completely in agreement just with the quadrant wavelength of the transmitted light, what is necessary is just abbreviation quadrant wavelength at extent in which neither the above-mentioned brightness fall nor generating of ZARATSUKI is conspicuous.
[0023] It is more desirable to specifically set the retardation of the field inboard of the above-mentioned 1st phase contrast layer as 95nm or more and 175nm or less, when setting light with a wavelength of 550nm to criteria.
[0024] With the above-mentioned configuration, since retardation is set as 95nm or more and 175nm or less, even if brightness falls, the fall of the brightness in the field of the fall of general brightness and orientation turbulence is suppressed to about 10%. Consequently, compared with the case where it is set as other range, the liquid crystal display which a brightness fall and ZARATSUKI cannot check by looking easily is realizable.
[0025] Moreover, it is more desirable to be the selective reflection layer which reflects the circular polarization of light which circles to hard flow, while making the circular polarization of light of the revolution direction which the above-mentioned circular polarization of light means is formed in the incidence side of the above-mentioned liquid crystal layer, and is defined beforehand penetrate in addition to the above-mentioned configuration.
[0026] With the configuration concerned, the circular polarization of light of the revolution direction beforehand defined among the incident light to a selective reflection layer penetrates a selective reflection layer. On the other hand, with the direction concerned, since it is reflected in a selective reflection layer, unlike the case where it is absorbed with a polarizer, the circular polarization of light which circles to hard flow is returned to the back light light source, and can be reused. Consequently, in spite of being able to carry out the incidence of the approximate circle polarization to a liquid crystal layer, the use effectiveness of light can be improved.
[0027] On the other hand, as a circular polarization of light means, instead of using a selective reflection layer, the above-mentioned circular polarization of light means was allotted between the polarizer prepared in the incidence side of the above-mentioned liquid crystal layer, the polarizer concerned, and the liquid crystal layer, and the retardation of field inboard may be equipped with the 2nd phase contrast layer set as the abbreviation quadrant wavelength of the wavelength of the transmitted light. Even if it is this case, since the linearly polarized light which carries out outgoing radiation of the polarizer is changed into approximate circle polarization in the 2nd phase contrast layer, it can carry out incidence of the approximate circle polarization to a liquid crystal layer. In addition, although an incidence [of a liquid crystal display] and outgoing radiation side may be the same side or you may be the opposite side, in the same side, an analyzer and a polarizer, or the 1st and 2nd phase contrast layer can be shared.
[0028] In addition to the above-mentioned configuration, the above-mentioned analyzer is arranged on one side of the above-mentioned liquid crystal layer. Furthermore, the above-mentioned polarizer While being allotted to another side, the include angle the transparency shaft of the above-mentioned analyzer and whose lagging axis of the 1st phase contrast layer are 45 degrees so that nothing and the include angle the transparency shaft of the above-mentioned polarizer and whose lagging axis of the 2nd phase contrast layer are 45 degrees may moreover be made It is more desirable to allot the 1st and 2nd phase contrast layer to the above-mentioned analyzer and the polarizer list.
[0029] With the configuration concerned, since the transparency shaft of the above-mentioned analyzer and the lagging axis of the 1st phase contrast layer are moreover making nothing and the include angle the transparency shaft of the above-mentioned polarizer and whose lagging axis of the 2nd phase contrast layer

are 45-degrees for the include angle which is 45 degrees, it is efficient and the interconversion of the linearly polarized light and the circular polarization of light can be carried out.

[0030] Moreover, it is more desirable to allot the above-mentioned 1st and 2nd phase contrast layer so that each lagging axis may intersect perpendicularly mutually, and to arrange the above-mentioned analyzer and a polarizer so that each transparency shaft may intersect perpendicularly mutually while in the configuration of to have the 1st and 2nd phase contrast layer the above-mentioned analyzer is arranged on one side of the above-mentioned liquid crystal layer and the above-mentioned polarizer is arranged on another side.

[0031] With the above-mentioned configuration, it is allotted so that the lagging axis of the 1st and 2nd phase contrast layer may intersect perpendicularly mutually. Therefore, the wavelength dispersion of the refractive-index anisotropy which both the phase contrast layer has is offset mutually. Consequently, in a black display condition, the transmitted light of the larger wavelength range is absorbed with an analyzer. A thereby still better black display is realizable.

[0032] Furthermore, it is more desirable to have the viewing-angle compensation layer to which the refractive-index anisotropy was set so that it may be prepared in from the above-mentioned analyzer before a polarizer and the phase contrast changed among the phase contrast which the above-mentioned liquid crystal layer gives according to whenever [from / of the 1st substrate of the above / a normal to a viewing angle / tilt-angle] may be negated, even if it is which configuration.

[0033] In the configuration concerned, the phase contrast which a liquid crystal layer gives is offset by whenever [tilt-angle / of a viewing angle] in a viewing-angle compensation layer. Therefore, the dependency of a viewing angle can be controlled and the liquid crystal display which has a good contrast ratio in the larger viewing-angle range can be realized.

[0034]

[Embodiment of the Invention] [1st operation gestalt] It is as follows when 1 operation gestalt of this invention is explained based on drawing 1 thru/or drawing 16 . The direction of orientation as a liquid crystal layer which is not fixed for example, at the time of no electrical-potential-difference impressing If orientation is carried out at right angles to a substrate and the direction of orientation makes an example the liquid crystal layer which presents the radial inclination orientation which changes continuously at the time of electrical-potential-difference impression, the liquid crystal panel 2 of the liquid crystal display 1 concerning this operation gestalt The liquid crystal cell 21 which contains the above-mentioned liquid crystal layer 21c pinched by TFT (Thin Film Transistor) substrate 21a, opposite substrate 21b, and both substrates 21a and 21b as shown in drawing 1 , lambda/4 plate (2nd phase contrast layer) 23a allotted between polarizing plate 22a and 22b allotted to the both sides of a liquid crystal cell 21, polarizing plate 22a by the side of the above-mentioned TFT substrate 21a, and a liquid crystal cell 21, It has lambda/4 plate 23b (the 1st phase contrast layer) allotted between polarizing plate 22b by the side of the above-mentioned opposite substrate 21b, and liquid crystal layer 21c. In addition, both the above-mentioned substrates 21a and 21b are equivalent to the 1st and 2nd substrates given in a claim. Moreover, polarizing plate 22a corresponds to a polarizer, and polarizing plate 22b corresponds to an analyzer.

[0035] TFT substrate 21a which arranged the pixel electrode 31 (after-mentioned) which the above-mentioned liquid crystal cell 21 is a liquid crystal cell of a perpendicular orientation (VA) method, and was formed by ITO (Indium Tin Oxide) etc., and the thin film transistor component which is not illustrated in the shape of a matrix -- and After applying the perpendicular orientation film which is not illustrated to opposite substrate 21b which has a counterelectrode, liquid crystal layer 21c which has a lamination and dielectric constant anisotropy further negative to the gap of both substrates 21a and 21b for both substrates 21a and 21b is enclosed, and it is created. Thereby, at the time of no electrical-potential-difference impressing, as shown in drawing 1 , while the liquid crystal molecule M of liquid crystal layer 21c carries out orientation to an abbreviation perpendicular, as shown in drawing 2 , a liquid crystal molecule inclines and orientation can be horizontally carried out at the time of electrical-potential-difference impression.

[0036] Furthermore, in liquid crystal cell 21c concerning this operation gestalt, as shown in drawing 3 , resin 32a by which the circular hole 32 was formed on each pixel electrode 31 prepared in TFT substrate 21a is prepared. As shown in drawing 4 , the wall surface H of a hole 32 inclines, and it carries out orientation of the liquid crystal molecule M near the wall surface H so that it may become perpendicular to the front face of a wall surface H. In addition, the electric field near the wall surface H incline in the direction which becomes parallel to the front face of a wall surface H at the time of electrical-potential-difference impression. In case the liquid crystal molecule M inclines these results at the time of electrical-potential-difference impression, as an arrow head shows in drawing 3 , the liquid crystal molecule M becomes easy to incline to the radial centering on the core of a hole 32 by field inboard, and each liquid crystal molecule M

of liquid crystal layer 21c can carry out inclination orientation of it to a radial. If applied voltage increases further, the tilt angle to the direction of a substrate normal becomes large, and each liquid crystal molecule M will be abbreviation parallel, and, moreover, will carry out orientation to a radial in a field in the display screen. In addition, on the above-mentioned TFT substrate 21a, resin 32a in which the above-mentioned hole 32 was formed applies light-sensitive nature resin, and can form it by processing it at a photolithography process.

[0037] Moreover, when a pixel pitch becomes large for example, only by forming a hole 32 in every one pixel electrode 31, the orientation restraining force of the central field of a hole 32 becomes weaker, and there is a possibility that orientation may become unstable. Therefore, it is more desirable to form two or more holes 32 on each pixel electrode 31, as shown in drawing 5 when the orientation restraining force of a central field is insufficient. In addition, 33 are source wiring among drawing and 34 shows gate wiring.

[0038] On the other hand, above-mentioned lambda/4 plate 23a, and 23b shown in drawing 1 are formed from the material which has birefringence anisotropies, such as a high polymer film which carried out uniaxial stretching, for example, and thickness (substrate normal lay length) is set up so that the optical path difference of an ordinary ray and an extraordinary ray may become the quadrant wavelength of incident light. Thereby, the linearly polarized light which has the polarization direction of 45 degrees to a lagging axis is convertible for the circular polarization of light. Moreover, when incidence of the circular polarization of light is carried out, it can change into the linearly polarized light which has the polarization direction of 45 degrees to the lagging axis of lambda / 4 plate 23a (23b). In addition, in case liquid crystal layer 21c is formed, in adding and carrying out axial symmetry orientation of the chiral agent, a twist angle occurs in liquid crystal layer 21c. Therefore, in consideration of the twist angle of liquid crystal layer 21c, the method of ZURA ** is desirable in the optical path difference of lambda / 4 plate 23a (23b) from quadrant wavelength in this case.

[0039] Moreover, in the liquid crystal panel 2 concerning this operation gestalt, the lagging axis SLa (SLb) of lambda / 4 plate 23a (23b) is set as the transparency shaft PAa (PAb) and list of polarizing plate 22a (22b) in the direction as shown in drawing 6 . Specifically, the lagging axis SLa of lambda/4 plate 23a is allotted so that the transparency shaft PAa of polarizing plate 22a and the include angle of 45 degrees may be made. Moreover, the lagging axis SLb of lambda/4 plate 23b is arranged so that the transparency shaft PAb of polarizing plate 22b and 45 degrees may be made in the same direction as the time of setting up the include angle of the above-mentioned lagging axis SLa and the transparency shaft PAa. In addition, in drawing 6 , when it sees along the direction of a substrate normal as an example from the opposite substrate 21b side, the case where it becomes 45 degrees is illustrated in the clockwise direction. Moreover, in this drawing, the time of no electrical-potential-difference impressing is shown, and the liquid crystal molecule M is carrying out orientation to the abbreviation perpendicular.

[0040] Furthermore, in the liquid crystal display 1 concerning this operation gestalt, as shown in drawing 1 , the back light 3 used as the light source of a liquid crystal display 1 is arranged on one side of the both sides of a liquid crystal panel 2. In addition, in the example of drawing 1 , the case where a back light 3 is arranged on the TFT substrate 21a side is illustrated.

[0041] With the above-mentioned configuration, while not impressing the electrical potential difference between the pixel electrode 31 and the counterelectrode which is not illustrated, as shown in drawing 1 , the liquid crystal molecule M of liquid crystal layer 21c is in a perpendicular orientation condition except for the a small number of molecule near the wall surface H of a hole 32. the light which carried out incidence from the back light 3 to the liquid crystal panel 2 in this condition (at the time of no electrical-potential-difference impressing) -- polarizing plate 22a -- a passage -- the polarization direction -- the lagging axis SLa of lambda/4 plate 23a -- receiving -- the linearly polarized light of 45 degrees -- becoming . Furthermore, the linearly polarized light concerned is passing lambda/4 plate 23a, and is changed into the circular polarization of light.

[0042] Here, the liquid crystal molecule M does not give phase contrast to the light which carries out incidence in the direction parallel to the direction of orientation. Therefore, liquid crystal layer 21c cannot give phase contrast to the light which carried out incidence from the back light 3 perpendicularly to liquid crystal layer 21c, but has almost no form birefringence.

[0043] Consequently, the circular polarization of light which carried out outgoing radiation of lambda/the 4 plate 23a passes liquid crystal layer 21c, with a polarization condition maintained, and incidence is carried out to lambda/4 plate 23b. As for the circular polarization of light concerned, the circular polarization of light's passage of lambda/4 plate 23b changes the polarization direction into the linearly polarized light of the direction of 45 degrees, i.e., the direction where it intersects perpendicularly with the transparency shaft

PAb of polarizing plate 22b, to the lagging axis SLb of lambda/4 plate 23b. Therefore, the linearly polarized light concerned is absorbed by polarizing plate 22b, and a liquid crystal display 1 indicates by black in the state of no electrical-potential-difference impressing.
[0044] On the other hand, if an electrical potential difference is impressed between the above-mentioned pixel electrode 31 and a counterelectrode, as shown in drawing 2 and drawing 7 , inclination orientation of the liquid crystal molecule M of liquid crystal layer 21c will be carried out to a radial. Even if it is in this condition, a polarization condition is changed like [a back light 3 to the liquid crystal cell 21] the time of no electrical-potential-difference impressing, and incidence of the circular polarization of light is carried out to liquid crystal layer 21c.
[0045] However, at the time of electrical-potential-difference impression, the direction of orientation of the liquid crystal molecule M changes, and inclination orientation is carried out to the radial. Here, although the liquid crystal molecule M does not give phase contrast to the light which carries out incidence in the direction parallel to the direction of orientation, when the direction of orientation differs from the direction of incidence, it can give the phase contrast according to both include angle to the transmitted light.
[0046] Consequently, except for few fields as for which the liquid crystal molecule M is carrying out orientation in the direction of a substrate normal, such as the case of the light which carries out incidence perpendicularly to a liquid crystal cell 21, for example, the central field of a hole 32 etc., liquid crystal layer 21c can give phase contrast to the transmitted light, and can change the polarization condition of the transmitted light. Therefore, generally the outgoing radiation light from a liquid crystal cell 21 changes to elliptically polarized light. Even if this elliptically polarized light passes lambda/4 plate 23b, unlike the time of no electrical-potential-difference impressing, it does not turn into the linearly polarized light. Therefore, a part can penetrate polarizing plate 22b among the light given through lambda/4 plate 23b to polarizing plate 22b from a liquid crystal cell 21. Here, it depends for the amount of the polarization which penetrates polarizing plate 22b on the magnitude of the phase contrast which liquid crystal layer 21c gives. Therefore, the electrical potential difference impressed to liquid crystal layer 21c is controlled, by adjusting the direction of orientation of the liquid crystal molecule M, the outgoing radiation quantity of light of a liquid crystal display 1 can be changed, and a gradation display is attained.
[0047] With the above-mentioned configuration, liquid crystal layer 21c carries out inclination orientation to a radial. therefore, the phase contrast given to the transmitted light in the whole liquid crystal molecule M relevant to the display of a certain pixel even if it sees a liquid crystal panel 2 from the direction (bearing within a field) where the components within a field differ mutually -- abbreviation -- it becomes the same. Consequently, compared with the case where all the liquid crystal molecules M relevant to the display of a certain pixel carry out inclination orientation in the single specific direction, a large angle of visibility is securable.
[0048] The liquid crystal molecule group which carries out inclination orientation exists in the direction whose component within a field of the direction of orientation corresponds with the sense of the linearly polarized light here in being the configuration that incidence of the linearly polarized light is carried out to liquid crystal layer 121c, even if it is the configuration in which liquid crystal layer 121c carries out inclination orientation to a radial like the liquid crystal display 101 shown in drawing 18 , in order to secure a large angle of visibility. Here, since these liquid crystal molecule groups cannot give phase contrast to the transmitted light irrespective of the direction component of a normal of the direction of orientation, the light which penetrated the liquid crystal molecule group concerned will be absorbed like the time of perpendicular orientation by polarizing plate 122b by the side of outgoing radiation.
[0049] Consequently, the permeability of the field which met in the direction of the linearly polarized light, and the field which met in the direction perpendicular to it will fall centering on the center position of a hole 32. Furthermore, for example, as shown in drawing 19 , since how depending on which orientation is in disorder changes with locations while the orientation of the liquid crystal molecule M is in disorder in response to the effect of external electric field etc., in the edge field of the pixel electrode 31, it will be checked by looking as ZARATSUKI.
[0050] On the other hand, since incidence of the circular polarization of light is carried out to the liquid crystal cell 21, in spite of having secured the large angle of visibility to the radial by inclination orientation with the configuration of this operation gestalt, the liquid crystal molecule M which cannot give phase contrast to the transmitted light is the liquid crystal molecule M which is carrying out orientation perpendicularly to the substrate side, when it sees from a transverse plane. Moreover, when it sees from across, it is the liquid crystal molecule M which is carrying out orientation in the same direction as the viewing-angle direction. Consequently, the liquid crystal molecularity which cannot contribute decreases,

and phase contrast can be given if not the same as that of a viewing angle on the both sides of the component within a field, and the direction component of a normal. Therefore, as shown in drawing 8 , the field where a shadow is displayed serves as only a center position of a hole 32, and the mid-position of the hole 32-32 which adjoins mutually, and can reduce sharply the field where a shadow is displayed also in the edge field of the pixel electrode 31. Furthermore, the number of the liquid crystal molecules M which can give phase contrast to the transmitted light increases irrespective of whether a shadow is checked by looking or not. These results, as shown in drawing 9 , the linearly polarized light becomes higher than the transparency reinforcement T101 of the conventional liquid crystal display 101 by which incidence is carried out, and transparency reinforcement's T1 of the liquid crystal display 1 concerning this operation gestalt can improve efficiency for light utilization (effective numerical aperture) and brightness. In addition, in drawing 9 , an axis of abscissa is set as the applied voltage [V] to the liquid crystal layer of each liquid crystal display 1-101, and the ratio (transparency reinforcement) of each permeability to the maximum permeability on the theory in a liquid crystal display (50% of the permeability of air) is illustrated.

[0051] In addition, in the above, the retardation of lambda/4 plate 23a, and 23b is set up so that incident light may turn into the circular polarization of light, but even if it is not completely the circular polarization of light, as long as it is the gap which is extent which brightness seldom falls and ZARATSUKI does not generate, the elliptically polarized light of approximate circle polarization is sufficient. It is the configuration of drawing 1 R> 1, and when the permeability in wavelength (550nm) with the highest visibility is measured, changing the retardation of lambda/4 plate 23a, and 23b (simulation), specifically, it comes to be shown in drawing 10 . If the rate of change of brightness is less than 10% (i.e., if permeability is 0.9 or more), the fall of brightness cannot be easily recognized by the observer and ZARATSUKI will also be hard to be checked by looking here. Therefore, the same effectiveness is acquired even if it is not completely the circular polarization of light, if it is the optimal if the retardation of lambda/4 plate 23a, and 23b is 135nm to the light near 550nm, and the range of it is 95nm or more and less than 175nm. In addition, if it separates from the above-mentioned range, while brightness will fall rapidly, ZARATSUKI resulting from a poor orientation field becomes is easy to be observed.

[0052] By the way, although there is effectiveness in the improvement in brightness, and ZARATSUKI prevention if the elliptically polarized light and the linearly polarized light near the circular polarization of light or the circular polarization of light are mutually convertible on wavelength with the highest visibility, namely, if above-mentioned lambda/4 plate 23a, and 23b are the wavelength concerned and abbreviation lambda / 4 conditions are fulfilled to above-mentioned numerical range extent It is more desirable to cross throughout a light band and to be able to change the elliptically polarized light and the linearly polarized light near the circular polarization of light or the circular polarization of light mutually, when performing the display which thinks a color tone as important especially. However, it is since it is generally difficult in lambda/4 plate 23aand23b of a monolayer to lose wavelength dispersion completely. For example, it will separate from lambda/4 conditions as the wavelength of light will shift from 550nm, if lambda/4 plate created so that visibility might fulfill lambda/4 conditions to the light of the highest wavelength (550nm) as lambda/4 plate 23aand23b is used. Consequently, in order to realize a black display, even if it set applied voltage as the value by which 550nm light is shaded, there is a possibility that the light which shifted from 550nm may pass polarizing plate 22b, and may color, and a phenomenon may occur.

[0053] When carrying out color display and control of a coloring phenomenon is called for, make the transparency shaft PAa of polarizing plate 22a, and the transparency shaft PAb of polarizing plate 22b intersect perpendicularly mutually, and make it therefore, more desirable for the lagging axis SLa of lambda/4 plate 23a and the lagging axis SLb of lambda/4 plate 23b to intersect perpendicularly mutually, as shown in drawing 11 . In addition, the include angle of the transparency shaft PAa and a lagging axis SLa and the include angle of the transparency shaft PAb and a lagging axis SLb are set up in the same direction by 45 degrees like drawing 6 .

[0054] In liquid crystal display 1a concerning the modification concerned, since the lagging axis SLa of lambda/4 plate 23a and the lagging axis SLb of lambda/4 plate 23b lie at right angles mutually, the wavelength dispersion of the refractive-index anisotropy which each of lambda/4 plates 23a and 23b has offsets each other. Consequently, in a black display condition, the good black display which can absorb polarizing plate 22b and does not have coloring in the transmitted light of the larger wavelength range is realizable.

[0055] In addition, although ** lambda / 4 plate 23a, and 23b may be formed with lambda/4 plate of a mutually different ingredient, if it can do, those who use the same ingredient, lambda manufactured by the same manufacture approach / 4 plate can realize [rather than] a liquid crystal display without coloring

cheaply using broadband lambda / 4 plate at least.
[0056] By the way, above-mentioned explanation explained the case where light carried out incidence at right angles to liquid crystal layer 21c, at the time of a black display. However, especially, with the liquid crystal display 1 of a transparency mold, although perpendicular incident light contributes to a display most, the light which carries out incidence to liquid crystal layer 21c from across (direction which inclined from [of a liquid crystal display 1] the screen normal) also contributes to a display. Here, as for slanting incident light, phase contrast is given by liquid crystal layer 21c of a perpendicular orientation condition. Therefore, when the screen of a liquid crystal display 1 is seen from across, in spite of being in the perpendicular orientation condition which should be in a black display condition originally, optical leakage occurs and there is a possibility that the contrast ratio of a display may fall.
[0057] Therefore, it is more desirable to form further the viewing-angle compensating plate (viewing-angle compensation layer) 24 which consists of a phase contrast plate with which the refractive-index anisotropy was set up so that the phase contrast over oblique-incidence light might be offset like liquid crystal display 1b shown in drawing 12 , when improvement in the contrast ratio in the direction of slant is called for. In addition, although the case where the viewing-angle compensating plate 24 which consists of a single phase contrast plate is formed in the outside (furthest side from liquid crystal layer 21c) of TFT substrate 21a as an example is illustrated in drawing 12 , it may not restrict to this, the laminating of two or more phase contrast plates may be carried out, and the viewing-angle compensating plate 24 may be formed. Moreover, it does not restrict to the outside of TFT substrate 21a, and the location in which the viewing-angle compensating plate 24 is formed may also be the outside of opposite substrate 21b, and may be established in the outside of both substrates 21a and 21b, respectively.
[0058] Even if it is which case, since the sum total of the phase contrast by the viewing-angle compensating plate 24 is set up so that the phase contrast over oblique-incidence light may be offset, it can control the above-mentioned optical leakage in the direction of slant, and can improve a contrast ratio. The liquid crystal display which has a good contrast ratio in all the viewing-angle range by this is realizable.
[0059] By the way, above, although the hole 32 realized radial inclination orientation, it does not restrict to this. For example, like liquid crystal display 1c shown in drawing 13 , even if it forms the abbreviation semi-sphere-like projection 35 in the pixel electrode 31 instead of a hole 32, radial inclination orientation is realizable. Even in this case, while carrying out orientation of the about 35-projection liquid crystal molecule M at right angles to the front face of projection 35, the electric field of the near part of projection 35 incline in the direction which becomes parallel to the front face of projection 35 at the time of electrical-potential-difference impression. Thereby, like the configuration of drawing 3 , as the drawing Nakaya mark shows, the liquid crystal molecule M becomes easy to incline to the radial centering on projection 35 by field inboard, and each liquid crystal molecule M of liquid crystal layer 21c can carry out inclination orientation of it to a radial. In addition, each projection 35 applies light-sensitive nature resin, and can form it by processing it at a photolithography process.
[0060] Moreover, although the case where each liquid crystal molecule M of liquid crystal layer 21c inclined, and the direction of orientation of each liquid crystal molecule M presented the radial which changed continuously mutually was made into the example and explained above at the time of electrical-potential-difference impression, it does not restrict to this. the direction of the orientation [as shown in drawing 1414 thru/or drawing 16 , divide a liquid crystal layer into two or more domains, and] at the time of electrical-potential-difference impression -- mutual -- things -- it is effective even if it uses the liquid crystal layer of a configuration (multi-domain orientation).
[0061] For example, in 1d of liquid crystal displays shown in drawing 14 , it replaces with the projection 35 of the shape of a semi-sphere shown in drawing 13 , and square drill-like projection 35a is formed in the pixel electrode 31. Near the projection 35a, orientation also of this configuration is carried out so that the liquid crystal molecule M may become perpendicular to each slant face. In addition, the electric field of the part of projection 35a incline in the direction which becomes parallel to the slant face of projection 35a at the time of electrical-potential-difference impression. The component within a field of whenever [orientation angle / of the liquid crystal molecule M] becomes equal to the component within a field of the direction of a normal of the nearest slant face (directions P1, P2, P3, or P4) these results at the time of electrical-potential-difference impression. Therefore, a pixel field is divided into four domains D1-D4 in which the directions of orientation at the time of an inclination differ mutually. Consequently, when 1d of liquid crystal displays is seen from a certain domain side, even if the permeability of the domain concerned falls, the permeability of a residual domain does not fall but can control decline in overall permeability. This stops easily being able to depend for the brightness of 1d of liquid crystal displays on bearing within a field

of a viewing angle.
[0062] Here, in the multi-domain orientation of quadrisection, the component within a field of the direction of orientation is limited. Therefore, even if it is the case where incidence of the linearly polarized light is carried out unlike the case of above-mentioned radial inclination orientation, the liquid crystal molecularity which cannot give phase contrast to the transmitted light is reducible by setting up so that the include angle of the above-mentioned directions P1-P4 and the direction of the linearly polarized light may turn into 45 degrees.
[0063] However, even if it sets up in this way, in the edge field of a periphery, the component within a field of the orientation condition of the liquid crystal molecule M of the direction of the linearly polarized light and the direction of orientation corresponds by turbulence of an orientation condition by that of turbulence or a cone, and there is a possibility that the liquid crystal molecularity which cannot give phase contrast to the transmitted light may increase the border areas B12, B23, B34, or B41 between domains, or among the pixel electrodes 31.
[0064] Since orientation is carried out so that it may support in the liquid crystal molecule M with which the liquid crystal molecule M exists in the domain of both sides, the orientation of the liquid crystal molecule M is not fixed, but, specifically, it is in an unstable condition in a border area. Consequently, by the little chance, if the balance of the orientation restraining force from the domain of both sides collapses, the orientation condition of a border area will change (inclination). Here, balance changes with longitudinal direction electric fields, degradation with the passage of time, etc. by the electrical potential difference impressed to not only the slight variation of the orientation restraining force in a production process but a gate signal line, or a source signal line. Therefore, change of an orientation condition not only differs for every part in a border area, but every picture elements differ. Consequently, when incidence of the linearly polarized light is carried out, there is a possibility that it may become ZARATSUKI and may be checked by looking.
[0065] Moreover, in an edge field, the orientation condition is changing continuously and tends to be influenced [the center section of the pixel electrode 31] of external electric fields, such as electric field from a source signal line or a gate signal line. Moreover, when orientation is being controlled by box-frame construction, it is easy to receive a three-dimensional strain. Thus, in an edge field, since it is easy to be influenced of a perimeter, orientation restraining force tends to become an ununiformity and the orientation condition of a liquid crystal molecule tends to change (inclination). Change of this orientation condition not only also differs for every part in a border area, but every pixels differ. Consequently, when incidence of the linearly polarized light is carried out to the liquid crystal layer of a multi-domain configuration, there is a possibility that turbulence of an orientation condition may serve as ZARATSUKI, and may be checked by looking.
[0066] On the other hand, with this operation gestalt, incidence of the circular polarization of light is carried out to the liquid crystal cell of multi-domain orientation by lambda/4 plate 23a. Consequently, as well as the case of radial inclination orientation even if the orientation condition of the liquid crystal molecule M is confused, unless the direction of orientation and viewing angle of a substrate normal component [not only the component within a field but] of the liquid crystal molecule M correspond, the liquid crystal molecule M concerned can be contributed to a display. Although the border area of not only the edge field of the pixel electrode 31 but a domain exists by this as a result of using the liquid crystal layer of multi-domain orientation for wide-field-of-view angle reservation, there is no ZARATSUKI and the high liquid crystal display of display grace can be realized.
[0067] In addition, while preparing stripe [at which the configuration within a field turns / the configuration of the direction of a normal / at a zigzag and abbreviation right angle with a crest type like liquid crystal display shown in drawing 15 , for example although projection 35a was prepared in 1d of liquid crystal displays of drawing 14 and multi-domain orientation is realized 1e]-like heights 36 -- in the pixel electrode 31, the heights 37 of a configuration can be similarly formed in the counterelectrode of opposite substrate 21b, and it can also realize. Spacing in the field inboard of both these heights 36-37 is allotted so that the normal of the slant face of heights 36 and the normal of the slant face of heights 37 may be in agreement. Moreover, like projection 35, 35a, etc., each above-mentioned heights 36-37 apply light-sensitive nature resin on the above-mentioned pixel electrode 31 and a counterelectrode, and can form it by processing it at a photolithography process.
[0068] With the above-mentioned structure, the field D1 near the line part and the liquid crystal molecule M of D2 (D3, D4) carry out orientation along both crest type slant faces among heights 36 by line parts L1 (L2) other than Corner C. In addition, the both line section L1 and L2 lie at right angles mutually.

. Consequently, each pixel can be divided into two or more mutually different domains D1 of the direction of orientation, and D2 (D3, D4).
[0069] Even if it is this configuration, the border area B13 of a domain and B24 exist so that each corner C may be connected. Moreover, the border area B12 of a domain and B34 exist so that a line part L1 and L2 may be met. Therefore, when carrying out incidence of the linearly polarized light to a liquid crystal cell, even if it leans the above-mentioned line part L1 within a field, and the direction of L2 45 degrees to the linearly polarized light, there is a possibility that turbulence of the direction condition of orientation in the border area B13 concerned, B24, B12, and B34 may be checked by looking as ZARATSUKI. The border area B13 to which Corner C is connected and B24 [in addition,] For example, although auxiliary capacity wiring which consists of a metal formed in TFT substrate 21a, the light-shielding film prepared in opposite substrate 21b as a color filter substrate can be hidden by arranging Corner C so that it may lap with the field shaded The border area B12 in alignment with a line part L1 and L2 and B34 cannot be hidden unless an excessive light-shielding film is prepared.
[0070] Moreover, the implementation approach of multi-domain orientation may prepare a slit not only in a thing but in the pixel electrode 31 or counterelectrode twisted to a projection, and may carry out orientation division. For example, in 1f of liquid crystal displays shown in drawing 16 R> 6, the orientation control aperture 38 which comes to connect the slit on Y characters with the symmetry in the vertical direction (direction parallel to one side of the abbreviation rectangle-like pixel electrodes 31 in a field) is formed on the counterelectrode of opposite substrate 21b like the liquid crystal cell given in JP,11-109391,A.
[0071] With the configuration concerned, among the front faces of opposite substrate 21b, the electric field like making the liquid crystal molecule M incline are not built, but the liquid crystal molecule M carries out orientation perpendicularly in the field [directly under] of the orientation control aperture 38. On the other hand, among the front faces of opposite substrate 21b, in the field around the orientation control aperture 38, electric field which avoid the orientation control aperture 38 and spread occur as opposite substrate 21b is approached. Consequently, the liquid crystal molecule M inclines in the direction where a major axis is perpendicular to electric field, and as an arrow head shows the component within a field of the direction of orientation of the liquid crystal molecule M among drawing, it becomes an abbreviation perpendicular each side of the orientation control aperture 38. Thereby, two or more domains D1-D4 can be formed into 1 pixel. In addition, in this drawing, the TFT component of explanation by which the drain was connected [the gate electrode] in fact [although illustration is omitted for convenience] to the pixel electrode 31 for the source electrode at the source signal line 33 at the gate signal line 34 is prepared.
[0072] However, even if it is this case, in the border area (field of orientation control aperture 38 directly under) of each domain, there is a possibility that turbulence and the disclination line DL to like may be checked by looking for the direction of orientation of the liquid crystal molecule M. In addition, since there will be no change in a border area existing like the above-mentioned official report although the appearance part of the disclination line DL can be equalized if the distance between the adjoining pixel electrodes 31 is set as Wp>d/2, and/or Ws>d/2 when slit width of d and the orientation control aperture 38 is set to Ws for the distance between Wp, the pixel electrode 31, and a counterelectrode, it is difficult to reduce the abnormalities in orientation completely.
[0073] Even if it is which case, since two or more domains are prepared in 1 pixel in order to expand an angle of visibility, by the liquid crystal cell of multi-domain orientation, a border area exists in a pixel (inside of a viewing area). Therefore, since the disclination line DL in alignment with the absorption shaft orientation (cross Nicol's prism) of polarizing plate 22a (22b) occurs in the orientation control aperture 38 and the condition of the disclination line DL changes for every location and every pixel with turbulence of the orientation condition in a border area when incidence of the linearly polarized light is carried out, there is a possibility that ZARATSUKI may be checked by looking.
[0074] On the other hand, with this operation gestalt, incidence of the circular polarization of light is carried out to the liquid crystal cell of multi-domain orientation. Although the border area of not only the edge field of the pixel electrode 31 but a domain exists by this as a result of using the liquid crystal cell of multi-domain orientation for wide-field-of-view angle reservation, a disclination line becomes the orientation control aperture 38 is hard to be observed. Therefore, there is no ZARATSUKI and the high liquid crystal display 1 of display grace can be realized.
[0075] In addition, although the case where the liquid crystal layer toward which the liquid crystal molecule M in a pixel inclines in the two or more bearings was used was made into the example and it explained with this operation gestalt at the time of electrical-potential-difference impression while having a negative dielectric constant anisotropy as an example of a liquid crystal cell and carrying out orientation

perpendicularly to the substrate side as initial orientation It has a forward dielectric constant anisotropy and the liquid crystal layer which carries out orientation to a horizontal and two or more bearings to a substrate side may be used at the time of initial orientation.
[0076] Even if it is which case, if it is a liquid crystal display using the liquid crystal layer by which the direction of orientation was controlled, this operation gestalt and the same effectiveness as abbreviation will be acquired so that the components within a field of the direction of orientation of each liquid crystal molecule M may differ mutually within 1 pixel, where a certain electrical potential difference is impressed.
[0077] Furthermore, even if it is the liquid crystal layer by which the direction of orientation of the liquid crystal molecule M was controlled so that the direction of orientation of the liquid crystal molecule M in a pixel may turn into single direction, in the edge part of a pixel, there is a possibility that the direction of orientation may be in disorder with the slanting electric field from bus wiring of a source signal line, a gate signal line, etc., for example. Therefore, where a certain electrical potential difference is impressed, if the component within a field of the direction of orientation of each liquid crystal molecule M is a liquid crystal display using a mutually different liquid crystal layer within 1 pixel, a certain amount of effectiveness will be acquired.
[0078] However, like multi-domain orientation or radial inclination orientation, where a certain electrical potential difference is impressed, if it is the liquid crystal layer by which the direction of orientation was controlled as the components within a field of the direction of orientation of each liquid crystal molecule M differ mutually within 1 pixel, turbulence and the display grace to like will tend to fall [an orientation condition] compared with the liquid crystal layer by which the direction of orientation was controlled to become single direction. Therefore, the direction which carries out incidence of the circular polarization of light to the liquid crystal layer concerned can improve display grace still more greatly.
[0079] Moreover, compared with the liquid crystal cell of TN (Twisted Nematic) method, the liquid crystal cell of a perpendicular orientation method has the high contrast of a display, and its monochrome level speed of response is quick. Furthermore, the bearing dependency within a field of a viewing angle can be controlled by combining radial inclination orientation or multi-domain orientation. Therefore, the liquid crystal display which filled all the bearing dependencies within a field of contrast, a speed of response, an angle of visibility, and a viewing angle and display grace with carrying out incidence of the circular polarization of light to the liquid crystal cell of multi-domain orientation or radial inclination orientation is realizable with a perpendicular orientation method. Radial inclination orientation has especially few bearing dependencies within a field, although ZARATSUKI is easy to be checked by looking compared with multi-domain orientation when it combines with the linearly polarized light. Therefore, a liquid crystal display with few bearing dependencies within a field can be realized, without reducing display grace by carrying out incidence of the circular polarization of light, and stopping ZARATSUKI like this operation gestalt.
[0080] The case where polarizing plate 22a, and lambda/4 plate 23a were prepared between a back light 3 and a liquid crystal cell 21 was explained as a circular polarization of light means for carrying out incidence of the circular polarization of light to [the 2nd operation gestalt] with the operation gestalt of the above 1st in time at a liquid crystal cell 21. However, since polarizing plate 22a absorbs oscillating components other than the transparency shaft PAa, the outgoing radiation quantity of light of polarizing plate 22a will be restricted to about 40% - 60% of the amount of incident light.
[0081] On the other hand, in 1g of liquid crystal displays concerning this operation gestalt, as shown in drawing 17 , the selective reflection layer 25 is formed as a circular polarization of light means replaced with the above-mentioned both member 22a and 23a. The circular polarization of light which circles to hard flow is characterized by reflecting, for example, the selective reflection layer 25 concerned can form it by the cholesteric-liquid-crystal film etc. while passing the circular polarization of light which circles to a certain one direction among incident light. The light by which the cholesteric-liquid-crystal film concerned has taken the helical structure, for example, incidence was carried out in the case of the cholesteric-liquid-crystal film of a counterclockwise twining helical structure is the process which passes along a helical structure, while separating into the left-handed circularly-polarized light and the right-handed circularly polarized light, the left-handed circularly-polarized light is reflected and the right-handed circularly polarized light is penetrated. Contrary to this, with the cholesteric liquid crystal of a clockwise twining helical structure, the right-handed circularly polarized light is reflected and the left-handed circularly-polarized light penetrates. By this, the circular polarization of light of the required revolution direction can be taken out. Moreover, selective reflection can be carried out in a broadband by considering as the film with which RASEN pitches differ in the thickness direction. The cholesteric-liquid-crystal film concerned irradiates ultraviolet rays at for example, a 2 organic-functions cholesteric monomer and a monofunctional

pneumatic monomer, and can be manufactured by using the speed difference of optical bridge formation. In addition, although to have selective reflection nature on the wavelength of a broadband is desired, the selective reflection layer 25 should just set up the wavelength in which selective reflection is possible according to the emission spectrum of a back light 3 so that the selective reflection of the light from a back light 3 can be carried out, when it is difficult. For example, when three-wave tubing is used for the back light 3, the selective reflection layer 25 should just have selective reflection nature in the three waves.
[0082] In 1g of liquid crystal displays of the above-mentioned configuration, the light which carried out outgoing radiation from the back light 3 is penetrating the selective reflection layer 25, it turns into the circular polarization of light of the desired revolution direction, and incidence is carried out to a liquid crystal cell 21. On the other hand, it is reflected in the selective reflection layer 25, and the circular polarization of light which circles to hard flow is returned to a back light 3. Here, a polarization condition is broken down in the back light 3 interior, and outgoing radiation of a part of circular polarization of light returned to the back light 3 is again carried out from a back light 3 in the selective reflection layer 25. Therefore, in 1g of liquid crystal displays concerning this operation gestalt, a part of light from the back light 3 absorbed by polarizing plate 22a of the liquid crystal display 1 of drawing 1 is reusable. Consequently, the efficiency for light utilization of a back light 3 can be improved, and a brighter liquid crystal display can be realized.
[0083]
[Effect of the Invention] The liquid crystal layer by which the liquid crystal display concerning this invention is controlled so that the directions of orientation of a liquid crystal molecule differ mutually in a pixel as mentioned above, It is prepared between the analyzer arranged on the outgoing radiation side of the above-mentioned liquid crystal layer, a circular polarization of light means to set the incident light to the above-mentioned liquid crystal layer as an approximate circle polarization condition, and the above-mentioned liquid crystal layer and an analyzer, and the retardation of field inboard is a configuration equipped with the 1st phase contrast layer set as the abbreviation quadrant wavelength of the wavelength of the transmitted light.
[0084] Other liquid crystal displays concerning this invention are the configurations that the liquid crystal layer which it replaces with the above-mentioned liquid crystal layer, and the direction of orientation of a liquid crystal molecule presents the radial inclination orientation which changes continuously as mentioned above is prepared.
[0085] It is the configuration that replace other liquid crystal displays with the pan concerning this invention as mentioned above at the above-mentioned liquid crystal layer, and the liquid crystal layer of multi-domain orientation is prepared.
[0086] In the liquid crystal display of each above-mentioned configuration, since incidence of the approximate circle polarization is carried out to a liquid crystal layer, unless the anisotropy about the direction of orientation of a liquid crystal layer is lost and the direction of orientation and the transmitted light of a liquid crystal molecule are in agreement on the both sides of the component within a field, and the direction of a substrate normal, a liquid crystal molecule can give phase contrast to the transmitted light. Therefore, for wide-field-of-view angle reservation, the direction of orientation of a liquid crystal molecule can be contributed to the improvement in brightness, unless the direction of orientation of the liquid crystal molecule with which orientation was in disorder is in agreement with a viewing angle, in spite of being easy to generate turbulence of an orientation condition, as a result of controlling to differ mutually in a pixel. Consequently, maintaining a large angle of visibility, high efficiency for light utilization can be secured and the effectiveness that improvement in a contrast ratio and the increment in the number of gradation are realizable is done so.
[0087] While, as for the liquid crystal display concerning this invention, the above-mentioned circular polarization of light means sets light with a wavelength of 550nm as an approximate circle polarization condition as mentioned above in addition to the above-mentioned configuration, the above-mentioned 1st phase contrast layer is the configuration that the retardation of field inboard is set as the 550nm abbreviation quadrant.
[0088] With the configuration concerned, incidence of the approximate circle polarization is carried out about the wavelength which is 550nm with human being's highest visibility, and a brightness fall and generating of ZARATSUKI can be prevented about the light of the wavelength concerned. Consequently, the effectiveness that the liquid crystal display with which neither a brightness fall nor ZARATSUKI can check approximate circle polarization by looking easily only on other wavelength compared with the case where incidence is carried out is realizable is done so.

[0089] The liquid crystal display concerning this invention is the configuration that the retardation of the field inboard of the above-mentioned 1st phase contrast layer is set as 95nm or more and 175nm or less in addition to the above-mentioned configuration, as mentioned above.
[0090] With the above-mentioned configuration, since retardation is set as 95nm or more and 175nm or less to the light whose wavelength is 550nm, even if brightness falls, the fall of the brightness in the field of the fall of general brightness and orientation turbulence is suppressed to about 10%. Consequently, the effectiveness that the liquid crystal display which a brightness fall and ZARATSUKI cannot check by looking easily is realizable compared with the case where it is set as other range is done so.
[0091] The liquid crystal display concerning this invention is a configuration which is the selective reflection layer which reflects the circular polarization of light which circles to hard flow while making the circular polarization of light of the revolution direction which the above-mentioned circular polarization of light means is formed in the incidence side of the above-mentioned liquid crystal layer in addition to the above-mentioned configuration, and is defined beforehand as mentioned above penetrate.
[0092] With the configuration concerned, with the direction defined beforehand, since it is reflected in a selective reflection layer, unlike the case where it is absorbed with a polarizer, the circular polarization of light which circles to hard flow is reusable. Consequently, in spite of being able to carry out the incidence of the approximate circle polarization to a liquid crystal layer, the effectiveness that the use effectiveness of light can be improved is done so.
[0093] As mentioned above, the liquid crystal display concerning this invention is arranged between the polarizer prepared in the incidence side of the above-mentioned liquid crystal layer instead of and the polarizer concerned, and a liquid crystal layer, and is the configuration that the retardation of field inboard is equipped with the 2nd phase contrast layer set as the abbreviation quadrant wavelength of the wavelength of the transmitted light. [a selective reflection layer]
[0094] Since the configuration concerned is also changed into approximate circle polarization in the 2nd phase contrast layer, the linearly polarized light which carries out outgoing radiation of the polarizer can carry out incidence of the approximate circle polarization to a liquid crystal layer. Consequently, maintaining a large angle of visibility, high efficiency for light utilization can be secured and the effectiveness that improvement in a contrast ratio and the increment in the number of gradation are realizable is done so.
[0095] While the above-mentioned analyzer is arranged for the liquid crystal display concerning this invention on one side of the above-mentioned liquid crystal layer in the above-mentioned configuration as mentioned above and the above-mentioned polarizer is arranged on another side, the transparency shaft of the above-mentioned analyzer and the lagging axis of the 1st phase contrast layer are the configurations of moreover making nothing and the include angle the transparency shaft of the above-mentioned polarizer and whose lagging axis of the 2nd phase contrast layer are 45 degrees for the include angle which is 45 degrees.
[0096] With the configuration concerned, since the transparency shaft of the above-mentioned analyzer and the lagging axis of the 1st phase contrast layer are moreover making nothing and the include angle the transparency shaft of the above-mentioned polarizer and whose lagging axis of the 2nd phase contrast layer are 45 degrees for the include angle which is 45 degrees, the effectiveness that it is efficient and the interconversion of the linearly polarized light and the circular polarization of light can be carried out is done so.
[0097] While the above-mentioned analyzer is arranged for the liquid crystal display concerning this invention on one side of the above-mentioned liquid crystal layer in the above-mentioned configuration as mentioned above and the above-mentioned polarizer is arranged on another side, the above-mentioned 1st and 2nd phase contrast layer is allotted so that each lagging axis may intersect perpendicularly mutually, and the above-mentioned analyzer and a polarizer are configurations allotted so that each transparency shaft may intersect perpendicularly mutually.
[0098] With the configuration concerned, it is allotted so that the lagging axis of the 1st and 2nd phase contrast layer may intersect perpendicularly mutually. Therefore, the wavelength dispersion of the refractive-index anisotropy which both the phase contrast layer has is offset mutually. Consequently, in a black display condition, the transmitted light of the larger wavelength range is absorbed with an analyzer. The effectiveness that a thereby still better black display is realizable is done so.
[0099] The liquid crystal display concerning this invention is a configuration equipped with the viewing-angle compensation layer to which the refractive-index anisotropy was set, as it is prepared in from the above-mentioned analyzer before a polarizer and the phase contrast changed among the phase contrast which the above-mentioned liquid crystal layer gives according to whenever [from / of the 1st substrate of

. the above / a normal to a viewing angle / tilt-angle] is negated in addition to each above-mentioned configuration as mentioned above.
[0100] In the configuration concerned, the phase contrast which a liquid crystal layer gives is offset by whenever [tilt-angle / of a viewing angle] in a viewing-angle compensation layer. Therefore, the dependency of a viewing angle can be controlled and the effectiveness that the liquid crystal display which has a good contrast ratio in the larger viewing-angle range is realizable is done so.

[Translation done.]

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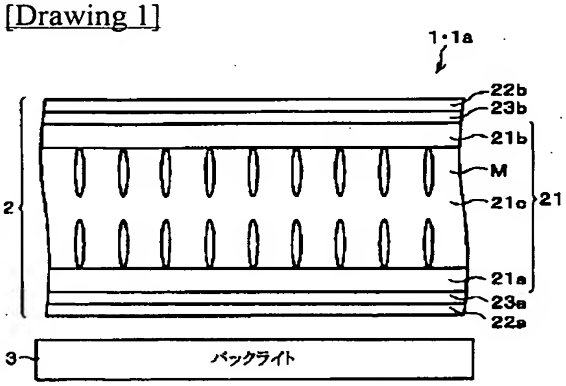
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



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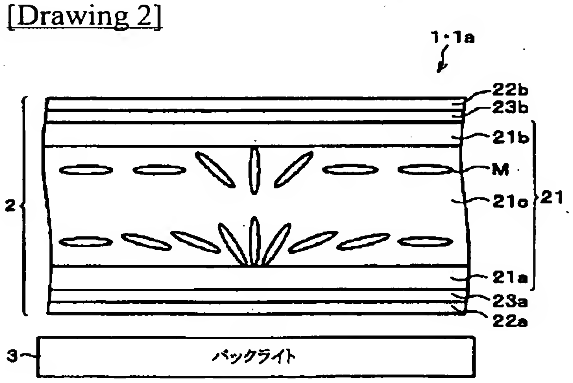

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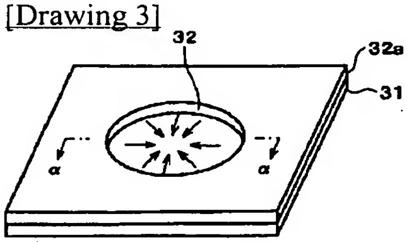

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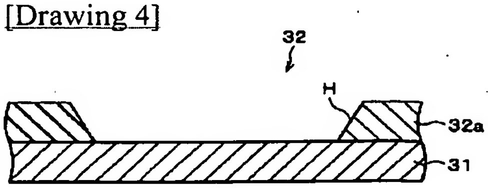

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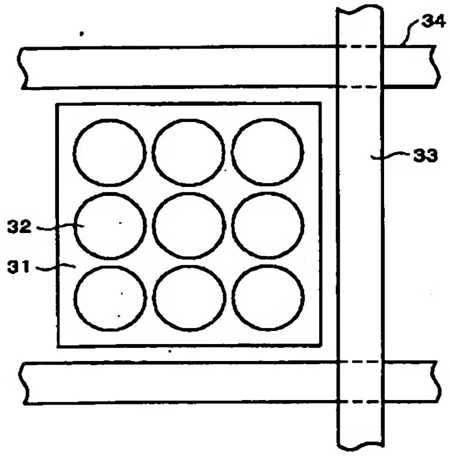

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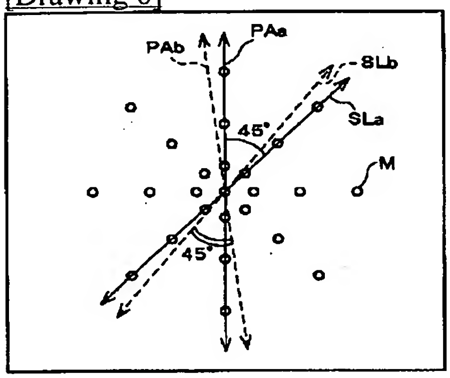

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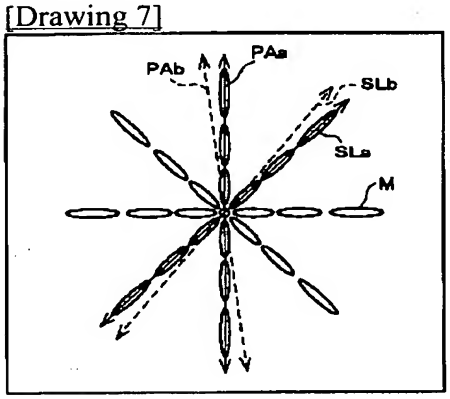

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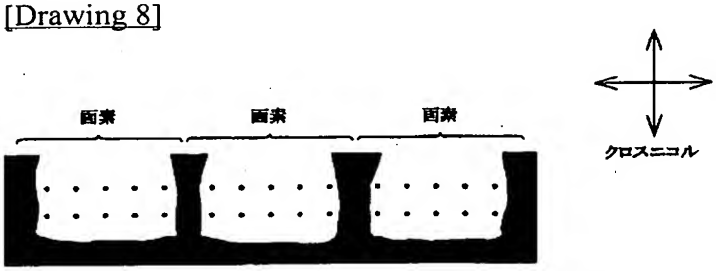

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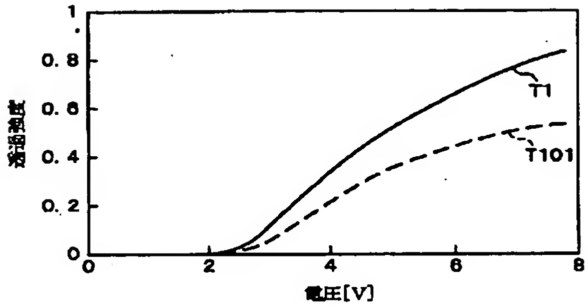

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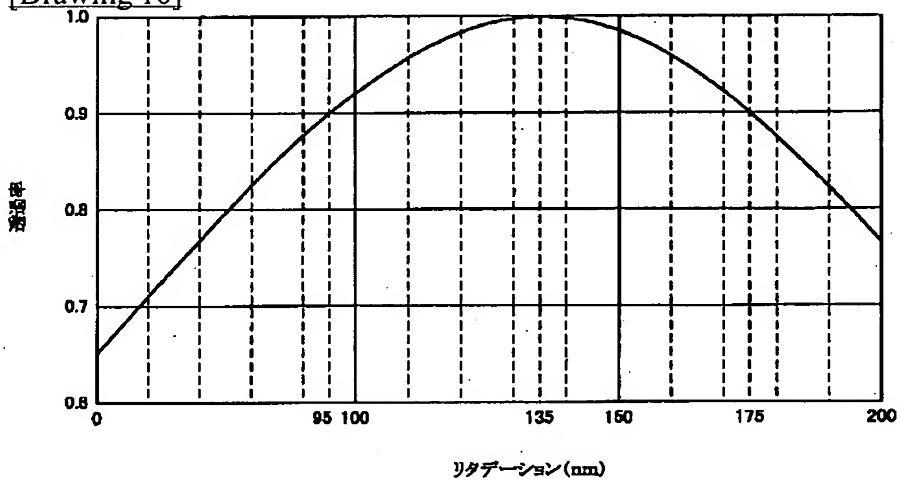

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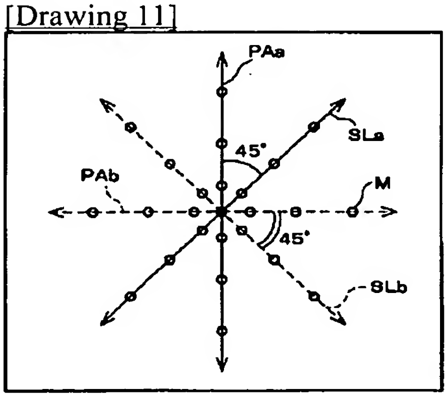

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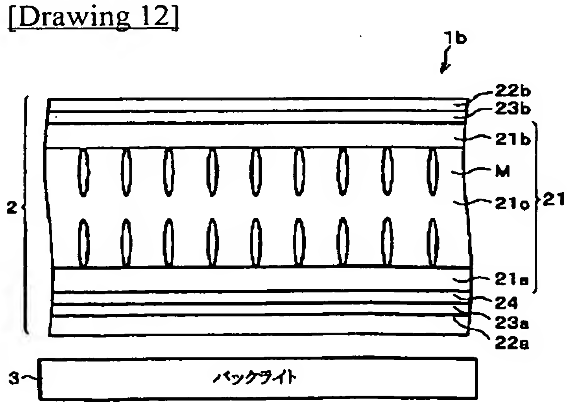

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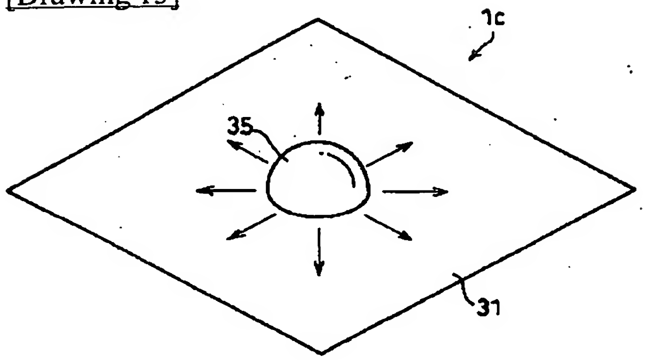

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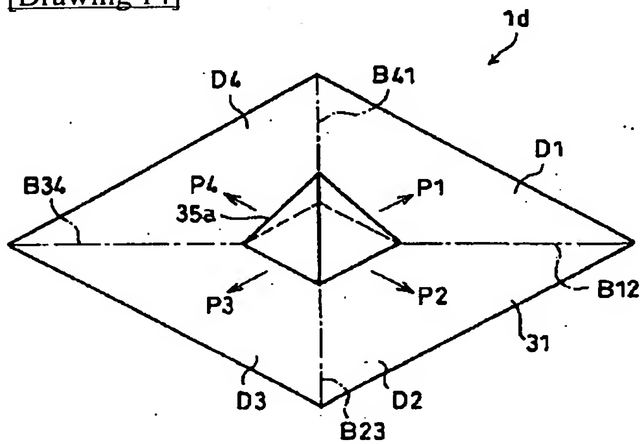

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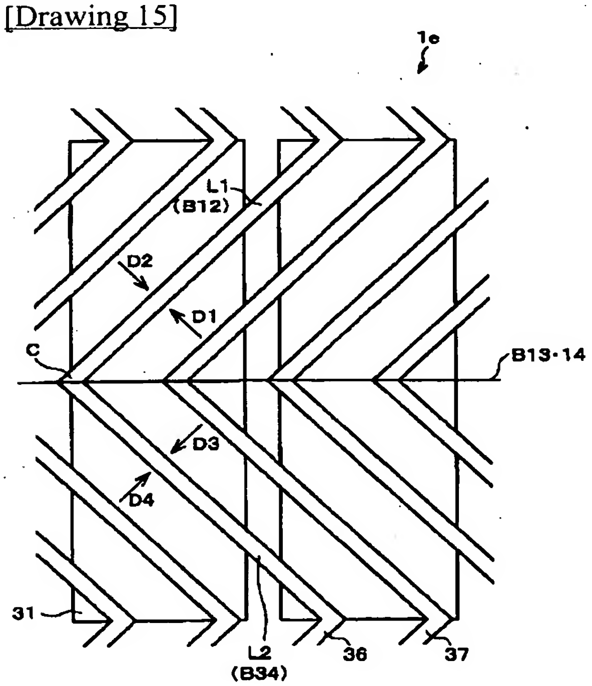

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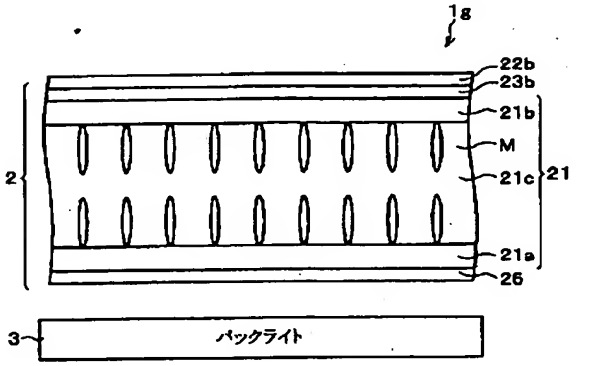

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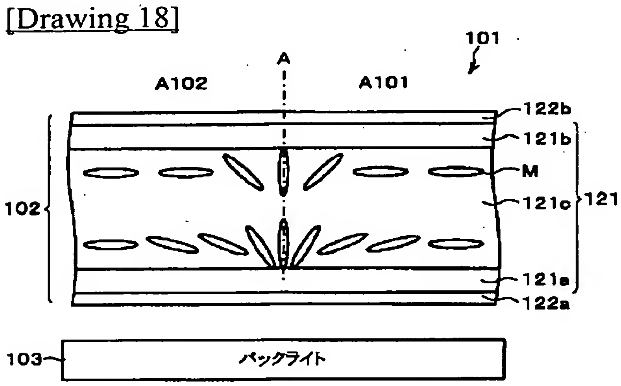

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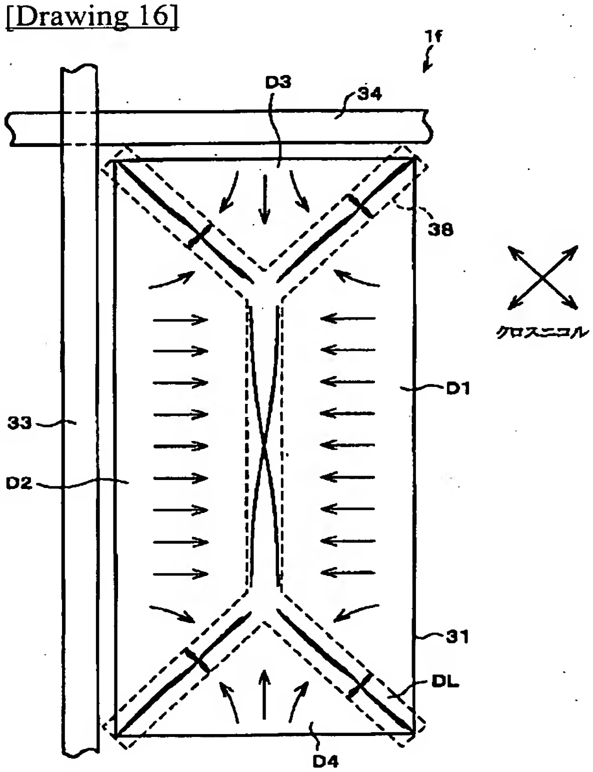

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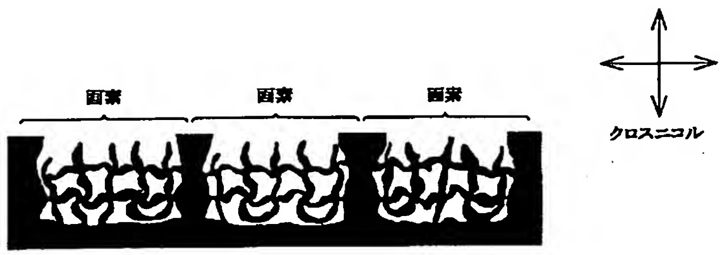

[Translation done.]

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Ｇ０２Ｂ	5/30		Ｇ０２Ｂ	5/30		２Ｈ０９０
Ｇ０２Ｆ	1/13363		Ｇ０２Ｆ	1/13363		２Ｈ０９１
Ｇ０９Ｆ	9/00	３１３	Ｇ０９Ｆ	9/00	３１３	５Ｇ４３５
		３２４			３２４	

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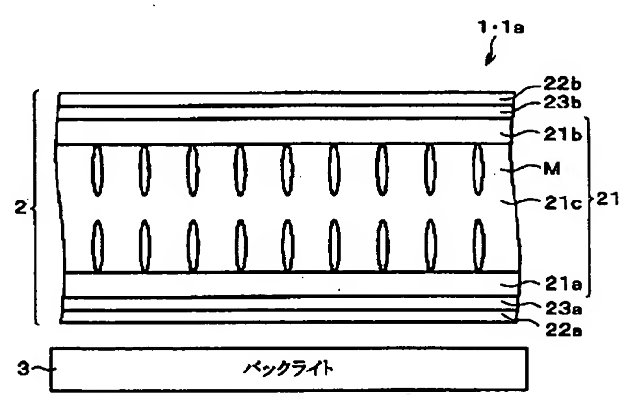
最終頁に続く

(54)【発明の名称】　液晶表示装置

(57)【要約】
【課題】　液晶分子の配向方向が画素中で互いに異なるように制御されている場合であっても、配向乱れが表示に影響せず、表示品位が低下しにくい液晶表示装置を実現する。
【解決手段】　液晶表示装置１において、電圧印加時に配向方向が連続的に変化する放射状傾斜配向を呈する液晶層２１には、λ／４板２３ａを通過した円偏光が入射される。この結果、液晶分子の配向状態が乱れたとしても、液晶分子の配向方向および視角が面内成分だけではなく基板法線成分も一致しない限り、当該液晶分子は、表示に寄与できる。これにより、広視野角確保のために、液晶分子の配向方向が画素中で互いに異なるように制御される液晶層を用いた結果、画素電極のエッジ領域だけではなく、ドメインの境界領域が存在しているにも拘らず、ザラツキがなく、表示品位の高い液晶表示装置１を実現できる。



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【特許請求の範囲】

【請求項１】画素に対応する画素電極が設けられた第１基板と、
対向電極が設けられた第２基板と、
当該両基板間に設けられ、上記画素電極と対向電極との間の電圧が、少なくとも予め定められる値の場合に、液晶分子の配向方向が画素中で互いに異なるように制御される液晶層と、
上記液晶層の出射側に配された検光子と、
上記液晶層への入射光を略円偏光状態に設定する円偏光手段と、
上記液晶層と検光子との間に設けられ、面内方向のリターデーションが、透過光の波長の略４分の１波長に設定された第１位相差層とを備えていることを特徴とする液晶表示装置。

【請求項２】画素に対応する画素電極が設けられた第１基板と、
対向電極が設けられた第２基板と、
当該両基板間に設けられ、上記画素電極と対向電極との間の電圧が、少なくとも予め定められる値の場合に、液晶分子の配向方向が連続的に変化する放射状傾斜配向を呈する液晶層と、
上記液晶層の出射側に配された検光子と、
上記液晶層への入射光を略円偏光状態に設定する円偏光手段と、
上記液晶層と検光子との間に設けられ、面内方向のリターデーションが、透過光の波長の略４分の１波長に設定された第１位相差層とを備えていることを特徴とする液晶表示装置。

【請求項３】画素に対応する画素電極が設けられた第１基板と、
対向電極が設けられた第２基板と、
当該両基板間に設けられ、上記画素電極と対向電極との間の電圧が、少なくとも予め定められる値の場合に、液晶分子の配向方向がマルチドメイン配向する液晶層と、
上記液晶層の出射側に配された検光子と、
上記液晶層への入射光を略円偏光状態に設定する円偏光手段と、
上記液晶層と検光子との間に設けられ、面内方向のリターデーションが、透過光の波長の略４分の１波長に設定された第１位相差層とを備えていることを特徴とする液晶表示装置。

【請求項４】上記円偏光手段は、５５０ｎｍの波長の光を略円偏光状態に設定すると共に、
上記第１位相差層は、面内方向のリターデーションが、５５０ｎｍの略４分の１に設定されていることを特徴とする請求項１、２または３記載の液晶表示装置。

【請求項５】上記リターデーションは、９５ｎｍ以上、１７５ｎｍ以下に設定されていることを特徴とする請求項４記載の液晶表示装置。

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【請求項６】上記円偏光手段は、上記液晶層の入射側に設けられ、予め定める旋回方向の円偏光を透過させると共に、逆方向に旋回する円偏光を反射する選択反射層であることを特徴とする請求項１、２、３、４または５記載の液晶表示装置。

【請求項７】上記円偏光手段は、上記液晶層の入射側に設けられた偏光子と、
当該偏光子および液晶層の間に配され、面内方向のリターデーションが、透過光の波長の略４分の１波長に設定された第２位相差層とを備えていることを特徴とする請求項１、２、３、４または５記載の液晶表示装置。

【請求項８】上記検光子は、上記液晶層の一方に配され、上記偏光子は、他方に配されていると共に、
上記検光子の透過軸と第１位相差層の遅相軸とが４５度の角度をなし、
しかも、上記偏光子の透過軸と第２位相差層の遅相軸とが４５度の角度をなすように、上記検光子、偏光子並びに第１および第２位相差層が配されていることを特徴とする請求項７記載の液晶表示装置。

【請求項９】上記検光子は、上記液晶層の一方に配され、上記偏光子は、他方に配されていると共に、
上記第１および第２位相差層は、それぞれの遅相軸が互いに直交するように配され、
上記検光子および偏光子は、それぞれの透過軸が互いに直交するように配されていることを特徴とする請求項７記載の液晶表示装置。

【請求項１０】上記検光子から偏光子までの間に設けられ、上記液晶層が付与する位相差のうち、上記第１基板の法線方向から視角までの傾斜角度に応じて変動する位相差を打ち消すように、屈折率異方性が設定された視角補償層を備えていることを特徴とする請求項１、２、３、４、５、６、７、８または９記載の液晶表示装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、例えば、放射状傾斜配向やマルチドメイン配向など、液晶分子の配向方向が画素中で互いに異なるように制御された液晶表示装置に関し、特に、配向状態の乱れなどに起因するザラツキを抑制して表示品位を向上可能な液晶表示装置に関するものである。

【０００２】

【従来の技術】例えば、ノートパソコンやワードプロセッサなどの表示画面として用いられている液晶表示装置では、液晶の光学異方性のため、ＣＲＴなどの表示装置に比べて、視野角が狭く、斜めから見た場合の表示品位が低下しがちである。したがって、例えば、特開平１１－２５８６０５号公報や特開平１１－１０９３９１号公報では、液晶の配向方向に複数の領域を形成する、いわゆるマルチドメイン方式が提案されている。

【０００３】マルチドメイン方式の液晶表示装置の一例

として、垂直配向膜と負の誘電異方性を持つ液晶を用いた垂直配向モードの液晶表示装置で、マルチドメイン化した構成について説明すると、電圧無印加状態では、液晶分子が垂直方向に配向している。この状態の液晶層に、偏光板から直線偏光が入射されると、液晶層が複屈折異方性を殆ど持たないので、偏光状態を維持したままの直線偏光が出射され、液晶層の反対側に配された偏光板で吸収される。この結果、液晶表示装置は、黒表示できる。

【0004】これとは逆に、電圧が印加されると、図18に示すように、液晶表示装置101の液晶層121cでは、印加電圧に応じて液晶分子Mが傾斜する。なお、同図では、液晶分子Mの配向方向が連続的に変化する放射状傾斜配向の場合を示しており、同一画素内であっても、液晶分子Mの配向方向は、放射状傾斜の中心軸Aを中心に、一方の領域A101と他方の領域A102とで、互いに異なっている。この状態で、偏光板122aから液晶層121cへ直線偏光が入射されると、液晶層121cは、透過光に位相差を与えることができ、透過光の偏光状態を変更できる。したがって、液晶セル121からの出射光は、一般には、楕円偏光に変化する。

【0005】当該楕円偏光が、液晶セル121の出射側に配された偏光板122bへ入射されると、電圧無印加時とは異なり、液晶層121cで与えられた位相差に応じた光量が透過する。したがって、液晶層121cへ印加する電圧を制御して、液晶分子Mの配向方向を調整することで、液晶表示装置101の出射光量を変更でき、階調表示が可能となる。

【0006】ここで、上記液晶表示装置101では、1画素中であっても液晶分子Mの配向方向が互いに異なっているので、斜めから見ることで、ある液晶分子Mを透過した光の出射光量が減少したとしても、当該液晶分子Mとは配向方向が異なる他の液晶分子Mの中には、出射光量を増加させるものも存在する。この結果、配向方向が互いに異なる液晶分子Mが存在する領域同士が、互いに光学的に補償し合い、斜めから見た場合の表示品位を改善し、視野角を拡大できる。

【0007】

【発明が解決しようとする課題】しかしながら、上記構成の液晶表示装置101のように、画素内の配向方向を別個に制御しようとすると、配向乱れが発生しやすい。したがって、例えば、ソース信号線やゲート信号線などからの外部電界など、単一の配向方向の場合には問題にならなかったような僅かな要因によっても配向乱れが発生する。ここで、配向乱れによって、配向乱れの発生した箇所が暗くなると、配向乱れが箇所毎や画素毎に異なっているため、表示にザラツキが観測され、表示品位を低下させるという問題を生ずる。

【0008】また、単一配向の場合に比べて配向方向が互いに異なるように制御されている場合、2枚の偏光板のもとでは、図19に示すように、必ず消光する方位が存在するので、全ての箇所で予定した透過率を維持する場合に比べて、画素全体の輝度も低下してしまう。この結果、液晶表示装置の光利用効率（実効開口率）も低下してしまう。

【0009】ここで、液晶表示装置の解像度や階調数は、年々、向上しており、1画素の面積が小さくなっても、より多くの階調を表示可能な液晶表示装置が求められている。ところが、上記配向乱れによって実効開口率が低下すると、白表示時の輝度が低下して階調数の向上が困難になってしまう。なお、画素面積を拡大すると輝度を向上できるが、解像度の向上が難しくなる。

【0010】本発明は、上記の問題点に鑑みてなされたものであり、その目的は、液晶分子の配向方向が画素中で互いに異なるように制御されている場合であっても、配向乱れが表示に影響せず、表示品位が低下しにくい液晶表示装置を実現することにある。

【0011】

【課題を解決するための手段】本発明に係る液晶表示装置は、上記課題を解決するために、画素に対応する画素電極が設けられた第1基板と、対向電極が設けられた第2基板と、当該両基板間に設けられ、上記画素電極と対向電極との間の電圧が、少なくとも予め定められる値の場合に、液晶分子の配向方向が画素中で互いに異なるように制御される液晶層と、上記液晶層の出射側に配された検光子と、上記液晶層への入射光を略円偏光状態に設定する円偏光手段と、上記液晶層と検光子との間に設けられ、面内方向のリターデーションが、透過光の波長の略4分の1波長に設定された第1位相差層とを備えていることを特徴としている。

【0012】また、本発明に係る他の液晶表示装置は、上記課題を解決するために、画素に対応する画素電極が設けられた第1基板と、対向電極が設けられた第2基板と、当該両基板間に設けられ、上記画素電極と対向電極との間の電圧が、少なくとも予め定められる値の場合に、液晶分子の配向方向が連続的に変化する放射状傾斜配向を呈する液晶層と、上記液晶層の出射側に配された検光子と、上記液晶層への入射光を略円偏光状態に設定する円偏光手段と、上記液晶層と検光子との間に設けられ、面内方向のリターデーションが、透過光の波長の略4分の1波長に設定された第1位相差層とを備えていることを特徴としている。

【0013】さらに、本発明に係るさらに他の液晶表示装置は、上記課題を解決するために、マルチドメイン配向の液晶層と、上記液晶層の出射側に配された検光子と、上記液晶層への入射光を略円偏光状態に設定する円偏光手段と、上記液晶層と検光子との間に設けられ、面内方向のリターデーションが、透過光の波長の略4分の1波長に設定された第1位相差層とを備えていることを特徴としている。

【0014】なお、上記各構成の液晶表示装置では、透過型の液晶表示装置のように、液晶表示装置の入射側と出射側とが反対方向であってもよいし、反射型の液晶表示装置のように、出射側と入射側とが同じであってもよい。

【0015】上記各構成の液晶表示装置では、液晶層には、略円偏光が入射され、液晶層から出射した光は、第1位相差層によって、4分の1波長の位相差が与えられた後、検光子に入射される。

【0016】上記液晶層の液晶分子が基板法線方向（垂直）に配向していると、液晶層は、透過光に位相差を与えることができない。この結果、透過光は、略円偏光を維持したまま、出射される。当該出射光は、第1位相差層で直線偏光に変換された後、検光子へ入力され、透過が制限される。この結果、液晶表示装置は、黒表示できる。一方、電圧印加時、あるいは、電圧無印加時の初期配向状態など、画素電極と対向電極との間の電圧が所定の電圧の場合には、液晶分子の配向方向が画素中で互いに異なるように制御される。この状態では、液晶層は、配向状態に応じた位相差を透過光に与えるので、円偏光は、楕円偏光に変換される。したがって、第1位相差層を透過しても直線偏光には戻らず、第1位相差層の出射光の一部が検光子から出射される。これらの結果、印加電圧に応じて検光子からの出射光量を制御でき、階調表示が可能となる。

【0017】また、液晶分子の配向方向が画素中で互いに異なっているので、配向方向の互いに異なる液晶分子が存在する領域同士が、互いに光学的に補償し合うことができる。この結果、斜めから見た場合の表示品位を改善し、視野角を拡大できる。

【0018】ここで、上記液晶層では、広視野角確保のために液晶分子の配向方向を画素中で互いに異なるように制御した結果、配向状態の乱れが発生しやすい。したがって、液晶層に直線偏光が入射され、液晶層の出射光が検光子に入射される従来の液晶表示装置の場合は、液晶分子の配向に乱れが発生して、配向方向の面内成分が、検光子の吸収軸と一致すると、基板法線方向成分に拘らず、当該液晶分子は、透過光に位相差を与えることができなくなってしまう。ここで、配向状態の乱れ方は、画素同士でも異なり、同じ画素内であっても場所によって異なるので、ザラツキが発生してしまう。また、配向方向の面内成分が検光子の吸収軸と一致した液晶分子が明るさ向上に寄与できないので、光利用効率（実効開口率）が低下する。これらの結果、コントラスト比の確保が難しくなり、階調数の増加も困難になってしまう。

【0019】これに対して、本発明に係る液晶表示装置では、略円偏光が液晶層に入射されるので、液晶層の配向方向についての異方性がなくなり、液晶分子の配向方向と透過光とが、面内成分と基板法線方向との双方で一致していない限り、液晶分子は、透過光に位相差を与えることができる。したがって、広視野角確保のために液晶分子の配向方向を画素中で互いに異なるように制御した結果、配向状態の乱れが発生しやすいにも拘らず、配向が乱れた液晶分子の配向方向が視角と一致していない限り、明るさ向上に寄与できる。この結果、広い視野角を保ちながら、高い光利用効率を確保でき、コントラスト比の向上と階調数の増加とを実現できる。

【0020】また、上記構成に加えて、上記円偏光手段は、５５０ｎｍの波長の光を略円偏光状態に設定すると共に、上記第１位相差層は、面内方向のリターデーションが、５５０ｎｍの略４分の１に設定されている方が好ましい。

【0021】当該構成では、人間の視感度が最も高い５５０ｎｍの波長について、略円偏光が入射され、当該波長の光について、明るさ低下とザラツキの発生とを防止できる。この結果、他の波長のみで、略円偏光を入射する場合に比べて、明るさ低下やザラツキが視認しにくい液晶表示装置を実現できる。

【0022】なお、上記円偏光手段は、円偏光を入射できればよいが、上記明るさ低下やザラツキの発生が目立たない程度に略円偏光を入射できればよい。また、第１位相差層のリターデーションも、透過光の４分の１波長に完全に一致すればよいが、上記明るさ低下やザラツキの発生が目立たない程度に略４分の１波長であればよい。

【0023】具体的には、５５０ｎｍの波長の光を基準に設定される場合、上記第１位相差層の面内方向のリターデーションは、９５ｎｍ以上、１７５ｎｍ以下に設定されている方が好ましい。

【0024】上記構成では、リターデーションが９５ｎｍ以上、１７５ｎｍ以下に設定されているので、明るさが低下したとしても、全般的な明るさの低下および配向乱れの領域における明るさの低下は、１０％程度に抑えられる。この結果、他の範囲に設定する場合に比べて、明るさ低下およびザラツキが視認しにくい液晶表示装置を実現できる。

【0025】また、上記構成に加えて、上記円偏光手段は、上記液晶層の入射側に設けられ、予め定める旋回方向の円偏光を透過させると共に、逆方向に旋回する円偏光を反射する選択反射層である方が望ましい。

【0026】当該構成では、選択反射層への入射光のうち、予め定める旋回方向の円偏光は、選択反射層を透過する。一方、当該方向とは逆方向に旋回する円偏光は、選択反射層にて反射されるので、偏光子で吸収される場合とは異なり、例えば、バックライト光源に戻されるなどして、再利用できる。この結果、液晶層へ略円偏光を入射できるにも拘らず、光の利用効率を向上できる。

【0027】一方、円偏光手段として、選択反射層を用いる代わりに、上記円偏光手段は、上記液晶層の入射側

に設けられた偏光子と、当該偏光子および液晶層の間に配され、面内方向のリターデーションが、透過光の波長の略４分の１波長に設定された第２位相差層とを備えていてもよい。この場合であっても、偏光子を出射する直線偏光が、第２位相差層で略円偏光に変換されるので、液晶層へ略円偏光を入射できる。なお、液晶表示装置の入射側と出射側とは、同じ側であっても反対側であってもよいが、同じ側の場合は、検光子および偏光子、あるいは、第１および第２位相差層を共用できる。

【００２８】さらに、上記構成に加えて、上記検光子は、上記液晶層の一方に配され、上記偏光子は、他方に配されていると共に、上記検光子の透過軸と第１位相差層の遅相軸とが４５度の角度をなし、しかも、上記偏光子の透過軸と第２位相差層の遅相軸とが４５度の角度をなすように、上記検光子、偏光子並びに第１および第２位相差層が配されている方が望ましい。

【００２９】当該構成では、上記検光子の透過軸と第１位相差層の遅相軸とが４５度の角度をなし、しかも、上記偏光子の透過軸と第２位相差層の遅相軸とが４５度の角度をなしているので、効率よく、直線偏光と円偏光とを相互変換できる。

【００３０】また、第１および第２位相差層を備える構成の場合、上記検光子は、上記液晶層の一方に配され、上記偏光子は、他方に配されていると共に、上記第１および第２位相差層は、それぞれの遅相軸が互いに直交するように配され、上記検光子および偏光子は、それぞれの透過軸が互いに直交するように配する方が望ましい。

【００３１】上記構成では、第１および第２位相差層の遅相軸が互いに直交するように配されている。したがって、両位相差層が有する屈折率異方性の波長分散は、互いに相殺される。この結果、黒表示状態において、より広い波長範囲の透過光が検光子によって吸収される。これにより、さらに良好な黒表示を実現できる。

【００３２】さらに、いずれの構成であっても、上記検光子から偏光子までの間に設けられ、上記液晶層が付与する位相差のうち、上記第１基板の法線方向から視角までの傾斜角度に応じて変動する位相差を打ち消すように、屈折率異方性が設定された視角補償層を備えている方が望ましい。

【００３３】当該構成では、視角の傾斜角度によって、液晶層が付与する位相差が、視角補償層で相殺される。したがって、視角の依存性を抑制でき、より広い視角範囲で良好なコントラスト比を有する液晶表示装置を実現できる。

【００３４】

【発明の実施の形態】〔第１の実施形態〕本発明の一実施形態について図１ないし図１６に基づいて説明すると以下の通りである。例えば、配向方向が一定ではない液晶層として、電圧無印加時には、基板に垂直に配向し、電圧印加時には、配向方向が連続的に変化する放射状傾斜配向を呈する液晶層を例にすると、本実施形態に係る液晶表示装置１の液晶パネル２は、図１に示すように、ＴＦＴ（Thin Film Transistor）基板２１ａ、対向基板２１ｂおよび両基板２１ａ・２１ｂで挟持された上記液晶層２１ｃを含む液晶セル２１と、液晶セル２１の両側に配された偏光板２２ａ・２２ｂと、上記ＴＦＴ基板２１ａ側の偏光板２２ａおよび液晶セル２１の間に配されたλ／４板（第２位相差層）２３ａと、上記対向基板２１ｂ側の偏光板２２ｂおよび液晶層２１ｃの間に配されたλ／４板２３ｂ（第１位相差層）とを備えている。なお、上記両基板２１ａおよび２１ｂが、特許請求の範囲に記載の第１および第２基板に対応する。また、偏光板２２ａが偏光子に対応し、偏光板２２ｂが検光子に対応する。

【００３５】上記液晶セル２１は、垂直配向（ＶＡ）方式の液晶セルであって、ＩＴＯ（Indium Tin Oxide）などで形成された画素電極３１（後述）と図示しない薄膜トランジスタ素子とをマトリクス状に配列したＴＦＴ基板２１ａ、および、対向電極を有する対向基板２１ｂに、図示しない垂直配向膜を塗布した後、両基板２１ａ・２１ｂを貼り合わせ、さらに、両基板２１ａ・２１ｂの間隙に負の誘電率異方性を有する液晶層２１ｃを封入するなどして作成される。これにより、電圧無印加時には、図１に示すように、液晶層２１ｃの液晶分子Ｍが略垂直に配向すると共に、電圧印加時には、図２に示すように、液晶分子が傾斜して水平に配向できる。

【００３６】さらに、本実施形態に係る液晶セル２１ｃでは、図３に示すように、ＴＦＴ基板２１ａに設けられた各画素電極３１上に、円形の穴部３２が形成された樹脂３２ａが設けられている。穴部３２の壁面Ｈは、図４に示すように、傾斜しており、壁面Ｈの近傍では、液晶分子Ｍは、壁面Ｈの表面に垂直になるように配向する。加えて、電圧印加時において、壁面Ｈ近傍の電界は、壁面Ｈの表面に平行になる方向に傾く。これらの結果、電圧印加時に液晶分子Ｍが傾斜する際、図３にて矢印で示すように、液晶分子Ｍは、面内方向で穴部３２の中心を中心にした放射状に傾きやすくなり、液晶層２１ｃの各液晶分子Ｍは、放射状に傾斜配向できる。また、印加電圧がさらに増加すると、基板法線方向に対する傾斜角が大きくなり、各液晶分子Ｍは、表示画面に略平行で、しかも、面内では放射状に配向する。なお、上記穴部３２が形成された樹脂３２ａは、上記ＴＦＴ基板２１ａ上に、光感応性樹脂を塗布し、フォトリソグラフィー工程で加工することで形成できる。

【００３７】また、例えば、画素ピッチが大きくなった場合、画素電極３１に１つずつ穴部３２を設けただけでは、穴部３２の中心領域の配向規制力が弱まり、配向が不安定になる虞れがある。したがって、中心領域の配向規制力が不足する場合には、図５に示すように、各画素電極３１上に複数の穴部３２を設ける方が望ましい。な

お、図中、３３は、ソース配線であり、３４は、ゲート配線を示している。

【００３８】一方、図１に示す上記λ／４板２３ａ・２３ｂは、例えば、一軸延伸した高分子フィルムなど、複屈折異方性を有する素材から形成され、常光線と異常光線との光路差が入射光の４分の１波長になるように厚み（基板法線方向の長さ）が設定されている。これにより、遅相軸に対して４５度の偏光方向を有する直線偏光を円偏光に変換できる。また、円偏光が入射された場合、λ／４板２３ａ（２３ｂ）の遅相軸に対して、４５度の偏光方向を有する直線偏光に変換できる。なお、液晶層２１ｃを形成する際、カイラル剤を添加して軸対称配向させている場合には、液晶層２１ｃにツイスト角が発生する。したがって、この場合は、液晶層２１ｃのツイスト角を考慮し、λ／４板２３ａ（２３ｂ）の光路差を、４分の１波長からズラす方が望ましい。

【００３９】また、本実施形態に係る液晶パネル２では、偏光板２２ａ（２２ｂ）の透過軸ＰＡａ（ＰＡｂ）、並びに、λ／４板２３ａ（２３ｂ）の遅相軸ＳＬａ（ＳＬｂ）は、図６に示すような方向に設定されている。具体的には、λ／４板２３ａの遅相軸ＳＬａは、偏光板２２ａの透過軸ＰＡａと４５度の角度をなすように配される。また、λ／４板２３ｂの遅相軸ＳＬｂは、上記遅相軸ＳＬａおよび透過軸ＰＡａの角度を設定したときと同じ方向に、偏光板２２ｂの透過軸ＰＡｂと４５度をなすように配置されている。なお、図６では、一例として、対向基板２１ｂ側から基板法線方向に沿って見たとき、右回りに４５度となる場合を図示している。また、同図では、電圧無印加時を示しており、液晶分子Ｍが略垂直に配向している。

【００４０】さらに、本実施形態に係る液晶表示装置１では、図１に示すように、液晶パネル２の両面のうちの一方には、液晶表示装置１の光源となるバックライト３が配されている。なお、図１の例では、ＴＦＴ基板２１ａ側にバックライト３を配した場合を図示している。

【００４１】上記構成では、画素電極３１と図示しない対向電極との間に電圧を印加していない間、図１に示すように、液晶層２１ｃの液晶分子Ｍは、穴部３２の壁面Ｈ近傍の少数分子を除いて、垂直配向状態にある。この状態（電圧無印加時）において、バックライト３から液晶パネル２へ入射した光は、偏光板２２ａを通り、偏光方向がλ／４板２３ａの遅相軸ＳＬａに対して４５度の直線偏光となる。さらに、当該直線偏光は、λ／４板２３ａを通過することで、円偏光に変換される。

【００４２】ここで、液晶分子Ｍは、配向方向に平行な方向に入射する光に位相差を与えない。したがって、液晶層２１ｃは、バックライト３から液晶層２１ｃへ垂直に入射した光へ位相差を与えることができず、殆ど複屈折性を持たない。

【００４３】この結果、λ／４板２３ａを出射した円偏光は、偏光状態を維持したままで液晶層２１ｃを通過し、λ／４板２３ｂへ入射される。円偏光がλ／４板２３ｂを通過すると、当該円偏光は、偏光方向がλ／４板２３ｂの遅相軸ＳＬｂに対して４５度の方向、すなわち、偏光板２２ｂの透過軸ＰＡｂに直交する方向の直線偏光に変換される。したがって、当該直線偏光は、偏光板２２ｂで吸収され、液晶表示装置１は、電圧無印加状態で黒表示できる。

【００４４】これに対して、上記画素電極３１と対向電極との間に電圧を印加すると、液晶層２１ｃの液晶分子Ｍは、図２および図７に示すように、放射状に傾斜配向する。この状態であっても、バックライト３から液晶セル２１までは、電圧無印加時と同様に偏光状態が変換され、液晶層２１ｃには、円偏光が入射される。

【００４５】ただし、電圧印加時には、液晶分子Ｍの配向方向が変化して、放射状に傾斜配向している。ここで、液晶分子Ｍは、配向方向に平行な方向に入射する光には位相差を与えないが、配向方向と入射方向とが異なっている場合には、両者の角度に応じた位相差を透過光へ与えることができる。

【００４６】この結果、液晶セル２１へ垂直に入射する光の場合、例えば、穴部３２の中心領域など、液晶分子Ｍが基板法線方向に配向している僅かな領域を除いて、液晶層２１ｃは、透過光に位相差を与えることができ、透過光の偏光状態を変更できる。したがって、液晶セル２１からの出射光は、一般には、楕円偏光に変化する。この楕円偏光は、λ／４板２３ｂを通過しても、電圧無印加時とは異なり、直線偏光にならない。したがって、液晶セル２１からλ／４板２３ｂを介して偏光板２２ｂへ与えられる光のうち、一部は、偏光板２２ｂを透過できる。ここで、偏光板２２ｂを透過する偏光の量は、液晶層２１ｃが与える位相差の大きさに依存する。したがって、液晶層２１ｃへ印加する電圧を制御して、液晶分子Ｍの配向方向を調整することで、液晶表示装置１の出射光量を変更でき、階調表示が可能となる。

【００４７】上記構成では、液晶層２１ｃが放射状に傾斜配向する。したがって、面内成分が互いに異なる方向（面内方位）から液晶パネル２を見たとしても、ある画素の表示に関連する液晶分子Ｍ全体では、透過光に与える位相差が略同じになる。この結果、ある画素の表示に関連する全液晶分子Ｍが単一の特定方向に傾斜配向する場合に比べて、広い視野角を確保できる。

【００４８】ここで、図１８に示す液晶表示装置１０１のように、広い視野角を確保するために、液晶層１２１ｃが放射状に傾斜配向する構成であっても、液晶層１２１ｃに直線偏光が入射される構成の場合には、配向方向の面内成分が、直線偏光の向きと一致する方向に傾斜配向する液晶分子群が存在する。ここで、これらの液晶分子群は、配向方向の法線方向成分に拘らず、透過光に位相差を与えることができないので、当該液晶分子群を透

過した光は、垂直配向時と同様に出射側の偏光板１２２ｂで吸収されてしまう。

【００４９】この結果、穴部３２の中心位置を中心に、直線偏光の方向に沿った領域、および、それに垂直な方向に沿った領域の透過率が低下してしまう。さらに、例えば、図１９に示すように、画素電極３１のエッジ領域では、外部電界などの影響を受けて液晶分子Ｍの配向が乱れると共に、配向の乱れ方が場所によって異なるので、ザラツキとして視認されてしまう。

【００５０】これに対して、本実施形態の構成では、液晶セル２１に円偏光が入射されているので、放射状に傾斜配向によって広い視野角を確保しているにも拘らず、透過光に位相差を与えることのできない液晶分子Ｍは、正面から見た場合、基板面に対して垂直に配向している液晶分子Ｍのみである。また、斜めから見た場合は、視角方向と同一の方向に配向している液晶分子Ｍのみである。この結果、寄与できない液晶分子数が少なくなり、面内成分および法線方向成分の双方で視角と同一でなければ、位相差を与えることができる。したがって、影が表示される領域は、図８に示すように、穴部３２の中心位置と、互いに隣接する穴部３２・３２の中間位置とのみとなり、画素電極３１のエッジ領域においても、影が表示される領域を大幅に縮小できる。さらに、影が視認されるか否かに拘らず、透過光に位相差を与えることのできる液晶分子Ｍの数が多くなる。これらの結果、図９に示すように、本実施形態に係る液晶表示装置１の透過強度Ｔ１は、直線偏光が入射される従来の液晶表示装置１０１の透過強度Ｔ１０１よりも高くなり、光利用効率（実効開口率）および輝度を向上できる。なお、図９では、各液晶表示装置１・１０１の液晶層への印加電圧〔Ｖ〕を横軸にして、液晶表示装置における理論上の最大透過率（空気の透過率の５０％）に対する、それぞれの透過率の比率（透過強度）を図示している。

【００５１】なお、上記では、入射光が円偏光となるように、λ／４板２３ａ・２３ｂのリターデーションを設定しているが、完全に円偏光でなくても、明るさが余り低下せず、ザラツキが発生しない程度のズレであれば、略円偏光の楕円偏光でもよい。具体的には、例えば、図１の構成で、λ／４板２３ａ・２３ｂのリターデーションを変化させながら、最も視感度の高い波長（５５０ｎｍ）における透過率を測定（シミュレーション）すると、図１０に示すようになる。ここで、明るさの変化率が１０％以内であれば、すなわち、透過率が０．９以上であれば、明るさの低下が観察者に認識されにくく、ザラツキも視認されにくい。したがって、λ／４板２３ａ・２３ｂのリターデーションは、５５０ｎｍ付近の光に対して、１３５ｎｍであれば、最適であり、９５ｎｍ以上かつ１７５ｎｍ以内の範囲であれば、完全に円偏光でなくても、同様の効果が得られる。なお、上記範囲を外れると、明るさが急激に低下すると共に、配向不良領域に起因するザラツキが観察されやすくなる。

【００５２】ところで、上記λ／４板２３ａ・２３ｂは、最も視感度の高い波長で円偏光または円偏光に近い楕円偏光と直線偏光とを相互に変換できれば、すなわち、当該波長で、上記数値範囲程度に略λ／４条件を満たしていれば、明るさ向上とザラツキ防止とに効果があるが、特に、色調を重視する表示を行う場合などには、可視光帯域全域に渡って、円偏光または円偏光に近い楕円偏光と直線偏光とを相互に変換できる方が好ましい。ただし、一般に単層のλ／４板２３ａ・２３ｂでは、波長分散を完全に無くすことが難しいので。例えば、λ／４板２３ａ・２３ｂとして、視感度が最も高い波長（５５０ｎｍ）の光に対して、λ／４条件を満たすように作成されたλ／４板を使用すると、光の波長が５５０ｎｍからズレるに従って、λ／４条件から外れてしまう。この結果、黒表示を実現するため、５５０ｎｍの光が遮光される値に印加電圧を設定したとしても、５５０ｎｍからズレた可視光が偏光板２２ｂを通過して色付き現象が発生する虞れがある。

【００５３】したがって、カラー表示する場合など、色付き現象の抑制が求められる場合には、図１１に示すように、偏光板２２ａの透過軸ＰＡａと偏光板２２ｂの透過軸ＰＡｂとを互いに直交させ、かつ、λ／４板２３ａの遅相軸ＳＬａとλ／４板２３ｂの遅相軸ＳＬｂとを互いに直交させる方が望ましい。なお、透過軸ＰＡａと遅相軸ＳＬａとの角度、および、透過軸ＰＡｂと遅相軸ＳＬｂとの角度は、図６と同様に、同一方向に４５度に設定される。

【００５４】当該変形例に係る液晶表示装置１ａでは、λ／４板２３ａの遅相軸ＳＬａとλ／４板２３ｂの遅相軸ＳＬｂとが互いに直交しているので、λ／４板２３ａおよび２３ｂのそれぞれが有する屈折率異方性の波長分散が、互いに相殺し合う。この結果、黒表示状態において、より広い波長範囲の透過光を偏光板２２ｂが吸収でき、色付きのない良好な黒表示を実現できる。

【００５５】なお、両λ／４板２３ａ・２３ｂを、互いに異なる材料のλ／４板で形成してもよいが、少なくとも同一材料、できれば、同一の製造方法で製造されたλ／４板を使用する方が、広帯域λ／４板を用いるよりも安価に、色付きのない液晶表示装置を実現できる。

【００５６】ところで、上述の説明では、黒表示の際、液晶層２１ｃに垂直に光が入射する場合について説明した。ところが、特に、透過型の液晶表示装置１では、垂直の入射光が最も表示に寄与するものの、液晶層２１ｃに対して斜め方向（液晶表示装置１の表示面法線方向から傾斜した方向）から入射する光も表示に寄与する。ここで、斜めの入射光は、垂直配向状態の液晶層２１ｃによっても位相差が与えられる。したがって、液晶表示装置１の表示面を斜めから見たとき、本来、黒表示状態であるべき垂直配向状態であるにも拘らず、光漏れが発生

し、表示のコントラスト比が低下する虞れがある。

【００５７】したがって、斜め方向でのコントラスト比の向上が求められる場合には、図１２に示す液晶表示装置１ｂのように、斜め入射光に対する位相差を相殺するように屈折率異方性が設定された位相差板からなる視角補償板（視角補償層）２４を、さらに設ける方が望ましい。なお、図１２では、一例として、ＴＦＴ基板２１ａの外側（液晶層２１ｃから最も遠い側）に、単一の位相差板からなる視角補償板２４を設けた場合を例示しているが、これに限るものではなく、複数の位相差板を積層して視角補償板２４を形成してもよい。また、視角補償板２４を設ける位置も、ＴＦＴ基板２１ａの外側に限るものではなく、対向基板２１ｂの外側であってもよいし、両基板２１ａ・２１ｂの外側に、それぞれ設けてもよい。

【００５８】いずれの場合であっても、視角補償板２４による位相差の合計が、斜め入射光に対する位相差を相殺するように設定されているので、斜め方向における上記光漏れを抑制でき、コントラスト比を向上できる。これにより、あらゆる視角範囲で良好なコントラスト比を有する液晶表示装置を実現できる。

【００５９】ところで、上記では、穴部３２によって、放射状傾斜配向を実現したが、これに限るものではない。例えば、図１３に示す液晶表示装置１ｃのように、穴部３２の代わりに、画素電極３１に略半球状の突起３５を設けても、放射状傾斜配向を実現できる。この場合でも、突起３５近傍の液晶分子Ｍは、突起３５の表面に垂直に配向すると共に、電圧印加時において、突起３５の近傍部分の電界は、突起３５の表面に平行になる方向に傾く。これにより、液晶分子Ｍは、図３の構成と同様に、図中矢印で示すように、面内方向で突起３５を中心にした放射状に傾きやすくなり、液晶層２１ｃの各液晶分子Ｍは、放射状に傾斜配向できる。なお、各突起３５は、光感応性樹脂を塗布し、フォトリソグラフィー工程で加工することで形成できる。

【００６０】また、上記では、電圧印加時に、液晶層２１ｃの各液晶分子Ｍが傾斜して、それぞれの液晶分子Ｍの配向方向が互いに連続的に変化した放射状を呈する場合を例にして説明したが、これに限るものではない。図１４ないし図１６に示すように、液晶層を複数のドメインに分割し、電圧印加時における配向方向が互いにことなる構成（マルチドメイン配向）の液晶層を用いても効果がある。

【００６１】例えば、図１４に示す液晶表示装置１ｄでは、図１３に示す半球状の突起３５に代えて、四角錐状の突起３５ａが画素電極３１に形成されている。この構成でも、突起３５ａの近傍では、液晶分子Ｍが各斜面に垂直になるように配向する。加えて、電圧印加時において、突起３５ａの部分の電界は、突起３５ａの斜面に平行になる方向に傾く。これらの結果、電圧印加時において、液晶分子Ｍの配向角度の面内成分は、最も近い斜面の法線方向の面内成分（方向Ｐ１、Ｐ２、Ｐ３またはＰ４）と等しくなる。したがって、画素領域は、傾斜時の配向方向が互いに異なる、４つのドメインＤ１～Ｄ４に分割される。この結果、あるドメイン側から液晶表示装置１ｄを見た場合、当該ドメインの透過率が低下したとしても、残余のドメインの透過率は低下せず、全体的な透過率の低下を抑制できる。これにより、液晶表示装置１ｄの明るさは、視角の面内方位に依存しにくくなる。

【００６２】ここで、４分割のマルチドメイン配向では、配向方向の面内成分が限定されている。したがって、上述の放射状傾斜配向の場合と異なり、直線偏光を入射する場合であっても、上記方向Ｐ１～Ｐ４と直線偏光の方向との角度が４５度になるように設定することで、透過光に位相差を与えることのできない液晶分子数を削減できる。

【００６３】ところが、このように設定したとしても、ドメイン間の境界領域Ｂ１２、Ｂ２３、Ｂ３４またはＢ４１、あるいは、画素電極３１のうち、外周のエッジ領域では、液晶分子Ｍの配向状態が乱れやすいので、配向状態の乱れによって、直線偏光の方向と配向方向の面内成分とが一致し、透過光に位相差を与えることのできない液晶分子数が増大する虞れがある。

【００６４】具体的には、境界領域では、液晶分子Ｍが両側のドメインに存在する液晶分子Ｍに支えられるように配向しているので、液晶分子Ｍの配向が固定されず、不安定な状態にある。この結果、ちょっとしたきっかけで、両側のドメインからの配向規制力のバランスが崩れると、境界領域の配向状態が変化（傾斜）してしまう。ここで、バランスは、製造工程における配向規制力の僅かなバラツキだけではなく、ゲート信号線やソース信号線に印加される電圧による横方向電界や経時劣化などによっても変化する。したがって、配向状態の変化は、境界領域内の各部分毎に異なるだけではなく、各絵素毎でも異なっている。この結果、直線偏光を入射すると、ザラツキとなって視認される虞れがある。

【００６５】また、エッジ領域では、配向状態が連続的に変化しており、画素電極３１の中央部に比べて、例えば、ソース信号線やゲート信号線からの電界など、外部の電界の影響を受けやすい。また、壁構造で配向を制御している場合には、立体的なひずみを受けやすい。このように、エッジ領域では、周囲の影響を受けやすいため、配向規制力が不均一になりやすく、液晶分子の配向状態が変化（傾斜）しやすい。この配向状態の変化も、境界領域内の各部分毎に異なるだけではなく、各画素毎でも異なっている。この結果、マルチドメイン構成の液晶層に直線偏光を入射すると、配向状態の乱れが、ザラツキとなって視認される虞れがある。

【００６６】これに対して、本実施形態では、λ／４板２３ａによって、マルチドメイン配向の液晶セルに円偏

光が入射される。この結果、液晶分子Mの配向状態が乱れたとしても、放射状傾斜配向の場合と同様に、液晶分子Mの配向方向および視角が面内成分だけではなく基板法線成分も一致しない限り、当該液晶分子Mは、表示に寄与できる。これにより、広視野角確保のためにマルチドメイン配向の液晶層を用いた結果、画素電極３１のエッジ領域だけではなく、ドメインの境界領域が存在しているにも拘らず、ザラツキがなく、表示品位の高い液晶表示装置を実現できる。

【００６７】なお、図１４の液晶表示装置１ｄでは、突起３５ａを設けてマルチドメイン配向を実現しているが、例えば、図１５に示す液晶表示装置１ｅのように、法線方向の形状が山型で、面内の形状がジグザグと略直角に曲がるストライプ状の凸部３６…を画素電極３１に設けると共に、対向基板２１ｂの対向電極にも、同様形状の凸部３７を設けて実現することもできる。これらの両凸部３６・３７の面内方向における間隔は、凸部３６の斜面の法線と凸部３７の斜面の法線とが一致するように配されている。また、上記各凸部３６・３７は、突起３５・３５ａなどと同様に、上記画素電極３１および対向電極上に光感応性樹脂を塗布し、フォトリソグラフィー工程で加工することで形成できる。

【００６８】上記構造では、凸部３６のうち、角部Ｃ以外の線部Ｌ１（Ｌ２）では、線部近傍の領域Ｄ１・Ｄ２（Ｄ３・Ｄ４）の液晶分子Mが山型の両斜面に沿って配向する。なお、両線部Ｌ１・Ｌ２は、互いに直交している。この結果、各画素を、配向方向の互いに異なる複数のドメインＤ１・Ｄ２（Ｄ３・Ｄ４）に分割できる。

【００６９】この構成であっても、各角部Ｃを結ぶように、ドメインの境界領域Ｂ１３・Ｂ２４が存在する。また、線部Ｌ１・Ｌ２に沿うように、ドメインの境界領域Ｂ１２・Ｂ３４が存在する。したがって、液晶セルに直線偏光を入射する場合は、面内における上記線部Ｌ１・Ｌ２の方向を直線偏光に対して４５度傾けたとしても、当該境界領域Ｂ１３・Ｂ２４・Ｂ１２・Ｂ３４における配向方向状態の乱れが、ザラツキとして視認される虞れがある。なお、角部Ｃを結ぶ境界領域Ｂ１３・Ｂ２４は、例えば、ＴＦＴ基板２１ａに形成する金属からなる補助容量配線や、カラーフィルタ基板としての対向基板２１ｂに設けられた遮光膜など、遮光される領域に重なるように、角部Ｃを配置することで、隠すことができるが、線部Ｌ１・Ｌ２に沿った境界領域Ｂ１２・Ｂ３４は、余分な遮光膜を設けない限り、隠すことができない。

【００７０】また、マルチドメイン配向の実現方法は、突起によるものに限らず、画素電極３１または対向電極にスリットを設けて配向分割してもよい。例えば、図１６に示す液晶表示装置１ｆでは、特開平１１－１０９３９１号公報に記載の液晶セルと同様、対向基板２１ｂの対向電極上にＹ字上のスリットを上下方向（面内で、略方形状の画素電極３１のいずれかの辺に平行な方向）に対称に連結してなる配向制御窓３８を設けている。

【００７１】当該構成では、対向基板２１ｂの表面のうち、配向制御窓３８の直下の領域では、液晶分子Mを傾斜させる程の電界がかからず、液晶分子Mが垂直に配向する。一方、対向基板２１ｂの表面のうち、配向制御窓３８の周囲の領域では、対向基板２１ｂに近づくに従って、配向制御窓３８を避けて広がるような電界が発生する。この結果、液晶分子Mは、長軸が電界に垂直な方向に傾き、液晶分子Mの配向方向の面内成分は、図中、矢印で示すように、配向制御窓３８の各辺に略垂直になる。これにより、１画素中に複数のドメインＤ１～Ｄ４を形成できる。なお、同図では、説明の便宜上、図示を省略しているが、実際には、ゲート電極がゲート信号線３４に、ソース電極がソース信号線３３に、ドレインが画素電極３１へ接続されたＴＦＴ素子が設けられている。

【００７２】ただし、この場合であっても、各ドメインの境界領域（配向制御窓３８直下の領域）では、液晶分子Mの配向方向が乱れやすく、ディスクリネーションラインＤＬが視認される虞れがある。なお、上記公報のように、隣接する画素電極３１間の距離をＷｐ、画素電極３１および対向電極間の距離をｄ、配向制御窓３８のスリット幅をＷｓとしたとき、Ｗｐ＞ｄ／２、および／または、Ｗｓ＞ｄ／２に設定すれば、ディスクリネーションラインＤＬの出現箇所を均一化できるが、境界領域が存在することには変わりがないため、配向異常を完全に削減することは難しい。

【００７３】いずれの場合であっても、マルチドメイン配向の液晶セルでは、視野角を拡大するため、１画素内に複数のドメインを設けているので、画素内（表示領域内）に境界領域が存在する。したがって、直線偏光を入射すると、境界領域での配向状態の乱れにより、配向制御窓３８において、偏光板２２ａ（２２ｂ）の吸収軸の方向（クロスニコル）に沿ったディスクリネーションラインＤＬが発生し、場所毎および画素毎にディスクリネーションラインＤＬの状態が異なるため、ザラツキが視認される虞れがある。

【００７４】これに対して、本実施形態では、マルチドメイン配向の液晶セルに円偏光を入射している。これにより、広視野角確保のためにマルチドメイン配向の液晶セルを用いた結果、画素電極３１のエッジ領域だけではなく、ドメインの境界領域が存在しているにも拘らず、配向制御窓３８には、ディスクリネーションラインが観察されにくくなる。したがって、ザラツキがなく、表示品位の高い液晶表示装置１を実現できる。

【００７５】なお、本実施形態では、液晶セルの一例として、負の誘電率異方性を有し、初期配向として、基板面に対して垂直に配向すると共に、電圧印加時に、画素内の液晶分子Mが複数方位に傾斜する液晶層を用いた場

合を例にして説明したが、正の誘電率異方性を有し、初期配向時には、基板面に対して水平かつ複数方位に配向する液晶層を用いてもよい。

【0076】いずれの場合であっても、ある電圧を印加した状態で、各液晶分子Mの配向方向の面内成分が1画素内で互いに異なるように、配向方向が制御された液晶層を用いた液晶表示装置であれば、本実施形態と略同様の効果が得られる。

【0077】さらに、画素内の液晶分子Mの配向方向が単一方向となるように、液晶分子Mの配向方向が制御された液晶層であっても、画素のエッジ部分では、例えば、ソース信号線やゲート信号線などのバス配線からの斜め電界によって、配向方向が乱れる虞れがある。したがって、ある電圧を印加した状態で、各液晶分子Mの配向方向の面内成分が1画素内で互いに異なる液晶層を用いた液晶表示装置であれば、ある程度の効果が得られる。

【0078】ただし、マルチドメイン配向や放射状傾斜配向のように、ある電圧を印加した状態で、各液晶分子Mの配向方向の面内成分が1画素内で互いに異なるように、配向方向が制御された液晶層であれば、単一方向となるように配向方向が制御された液晶層に比べて、配向状態が乱れやすく、表示品位が低下しやすい。したがって、当該液晶層に円偏光を入射する方が表示品位をさらに大きく向上できる。

【0079】また、垂直配向方式の液晶セルは、TN（Twisted Nematic ）方式の液晶セルに比べて、表示のコントラストが高く、白黒レベル応答速度が速い。さらに、放射状傾斜配向またはマルチドメイン配向を組み合わせることによって、視角の面内方位依存性を抑制できる。したがって、垂直配向方式で、マルチドメイン配向または放射状傾斜配向の液晶セルへ円偏光を入射することで、コントラスト、応答速度、視野角、視角の面内方位依存性および表示品位の全てを満たした液晶表示装置を実現できる。特に、放射状傾斜配向は、マルチドメイン配向と比べて、直線偏光と組み合わせた場合にザラツキが視認されやすいが、面内方位依存性が少ない。したがって、本実施形態のように、円偏光を入射して、ザラツキを抑えることによって、表示品位を低下させることなく、面内方位依存性が少ない液晶表示装置を実現できる。

【0080】〔第2の実施形態〕ところで、上記第1の実施形態では、液晶セル21に円偏光を入射するための円偏光手段として、バックライト3と液晶セル21との間に偏光板22aおよびλ／4板23aを設けた場合について説明した。ところが、偏光板22aは、透過軸PAa以外の振動成分を吸収するため、偏光板22aの出射光量は、入射光量の約40％～60％に制限されてしまう。

【0081】これに対して、本実施形態に係る液晶表示装置1gでは、図17に示すように、上記両部材22a・23aに代わる円偏光手段として、選択反射層25が設けられている。当該選択反射層25は、入射光のうち、ある一方向に旋回する円偏光は通過させると共に、逆方向に旋回する円偏光は反射することを特徴としており、例えば、コレステリック液晶膜などで形成できる。当該コレステリック液晶膜は、ラセン構造をとっており、例えば、左巻きラセン構造のコレステリック液晶膜の場合、入射された光は、ラセン構造を通る過程で、左円偏光と右円偏光とに分離されると共に、左円偏光は反射され、右円偏光は透過する。これとは逆に、右巻きラセン構造のコレステリック液晶では、右円偏光が反射され、左円偏光が透過する。これによって、必要な旋回方向の円偏光を取り出すことができる。また、厚み方向でラセンピッチの異なる膜とすることで、広帯域で選択反射することができる。当該コレステリック液晶膜は、例えば、二官能コレステリックモノマーと単官能ネマティックモノマーとに紫外線を照射し、光架橋の速度差を利用することで製造できる。なお、選択反射層25は、広帯域の波長で選択反射性を有することが望まれるが、それが難しい場合は、バックライト3からの光を選択反射できるように、バックライト3の発光スペクトルに合わせて、選択反射可能な波長を設定すればよい。例えば、バックライト3に3波長管が用いられている場合には、選択反射層25は、その3波長において選択反射性を有していればよい。

【0082】上記構成の液晶表示装置1gでは、バックライト3から出射した光は、選択反射層25を透過することで、所望の旋回方向の円偏光となり、液晶セル21へ入射される。一方、逆方向に旋回する円偏光は、選択反射層25で反射され、バックライト3に戻される。ここで、バックライト3に戻された円偏光の一部は、バックライト3内部で偏光状態が崩されて、再度、バックライト3から選択反射層25へ出射される。したがって、本実施形態に係る液晶表示装置1gでは、図1の液晶表示装置1の偏光板22aで吸収されていたバックライト3からの光の一部を再利用できる。この結果、バックライト3の光利用効率を向上でき、より明るい液晶表示装置を実現できる。

【0083】

【発明の効果】本発明に係る液晶表示装置は、以上のように、液晶分子の配向方向が画素中で互いに異なるように制御される液晶層と、上記液晶層の出射側に配された検光子と、上記液晶層への入射光を略円偏光状態に設定する円偏光手段と、上記液晶層と検光子との間に設けられ、面内方向のリターデーションが、透過光の波長の略4分の1波長に設定された第1位相差層とを備えている構成である。

【0084】本発明に係る他の液晶表示装置は、以上のように、上記液晶層に代えて、液晶分子の配向方向が連

続的に変化する放射状傾斜配向を呈する液晶層が設けられている構成である。

【００８５】本発明に係るさらに他の液晶表示装置は、以上のように、上記液晶層に代えて、マルチドメイン配向の液晶層が設けられている構成である。

【００８６】上記各構成の液晶表示装置では、略円偏光が液晶層に入射されるので、液晶層の配向方向についての異方性がなくなり、液晶分子の配向方向と透過光とが、面内成分と基板法線方向との双方で一致していない限り、液晶分子は、透過光に位相差を与えることができる。したがって、広視野角確保のために液晶分子の配向方向を画素中で互いに異なるように制御した結果、配向状態の乱れが発生しやすいにも拘らず、配向が乱れた液晶分子の配向方向が視角と一致していない限り、明るさ向上に寄与できる。この結果、広い視野角を保ちながら、高い光利用効率を確保でき、コントラスト比の向上と階調数の増加とを実現できるという効果を奏する。

【００８７】本発明に係る液晶表示装置は、以上のように、上記構成に加えて、上記円偏光手段は、５５０ｎｍの波長の光を略円偏光状態に設定すると共に、上記第１位相差層は、面内方向のリターデーションが、５５０ｎｍの略４分の１に設定されている構成である。

【００８８】当該構成では、人間の視感度が最も高い５５０ｎｍの波長について、略円偏光が入射され、当該波長の光について、明るさ低下とザラツキの発生とを防止できる。この結果、他の波長のみで、略円偏光を入射する場合に比べて、明るさ低下やザラツキが視認しにくい液晶表示装置を実現できるという効果を奏する。

【００８９】本発明に係る液晶表示装置は、以上のように、上記構成に加えて、上記第１位相差層の面内方向のリターデーションは、９５ｎｍ以上、１７５ｎｍ以下に設定されている構成である。

【００９０】上記構成では、波長が５５０ｎｍの光に対して、リターデーションが９５ｎｍ以上、１７５ｎｍ以下に設定されているので、明るさが低下したとしても、全般的な明るさの低下および配向乱れの領域における明るさの低下は、１０％程度に抑えられる。この結果、他の範囲に設定する場合に比べて、明るさ低下およびザラツキが視認しにくい液晶表示装置を実現できるという効果を奏する。

【００９１】本発明に係る液晶表示装置は、以上のように、上記構成に加えて、上記円偏光手段は、上記液晶層の入射側に設けられ、予め定める旋回方向の円偏光を透過させると共に、逆方向に旋回する円偏光を反射する選択反射層である構成である。

【００９２】当該構成では、予め定める方向とは逆方向に旋回する円偏光は、選択反射層にて反射されるので、偏光子で吸収される場合とは異なり、再利用できる。この結果、液晶層へ略円偏光を入射できるにも拘らず、光の利用効率を向上できるという効果を奏する。

【００９３】本発明に係る液晶表示装置は、以上のように、選択反射層の代わりに、上記液晶層の入射側に設けられた偏光子と、当該偏光子および液晶層の間に配され、面内方向のリターデーションが、透過光の波長の略４分の１波長に設定された第２位相差層とを備えている構成である。

【００９４】当該構成でも、偏光子を出射する直線偏光が、第２位相差層で略円偏光に変換されるので、液晶層へ略円偏光を入射できる。この結果、広い視野角を保ちながら、高い光利用効率を確保でき、コントラスト比の向上と階調数の増加とを実現できるという効果を奏する。

【００９５】本発明に係る液晶表示装置は、以上のように、上記構成において、上記検光子は、上記液晶層の一方に配され、上記偏光子は、他方に配されていると共に、上記検光子の透過軸と第１位相差層の遅相軸とが４５度の角度をなし、しかも、上記偏光子の透過軸と第２位相差層の遅相軸とが４５度の角度をなす構成である。

【００９６】当該構成では、上記検光子の透過軸と第１位相差層の遅相軸とが４５度の角度をなし、しかも、上記偏光子の透過軸と第２位相差層の遅相軸とが４５度の角度をなしているので、効率よく、直線偏光と円偏光とを相互変換できるという効果を奏する。

【００９７】本発明に係る液晶表示装置は、以上のように、上記構成において、上記検光子は、上記液晶層の一方に配され、上記偏光子は、他方に配されていると共に、上記第１および第２位相差層は、それぞれの遅相軸が互いに直交するように配され、上記検光子および偏光子は、それぞれの透過軸が互いに直交するように配される構成である。

【００９８】当該構成では、第１および第２位相差層の遅相軸が互いに直交するように配されている。したがって、両位相差層が有する屈折率異方性の波長分散は、互いに相殺される。この結果、黒表示状態において、より広い波長範囲の透過光が検光子によって吸収される。これにより、さらに良好な黒表示を実現できるという効果を奏する。

【００９９】本発明に係る液晶表示装置は、以上のように、上記各構成に加えて、上記検光子から偏光子までの間に設けられ、上記液晶層が付与する位相差のうち、上記第１基板の法線方向から視角までの傾斜角度に応じて変動する位相差を打ち消すように、屈折率異方性が設定された視角補償層を備えている構成である。

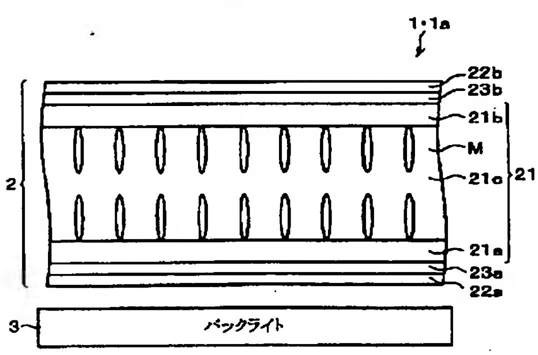
【０１００】当該構成では、視角の傾斜角度によって、液晶層が付与する位相差が、視角補償層で相殺される。したがって、視角の依存性を抑制でき、より広い視角範囲で良好なコントラスト比を有する液晶表示装置を実現できるという効果を奏する。

【図面の簡単な説明】

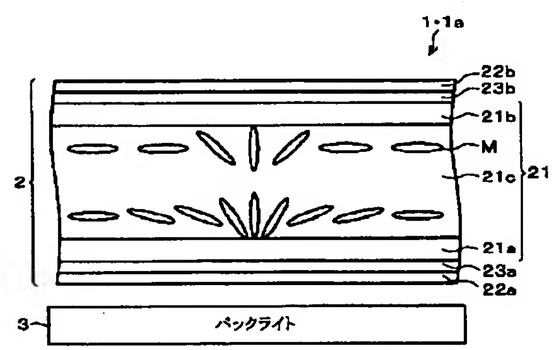
【図１】本発明の一実施形態を示すものであり、電圧無

印加時における液晶表示装置の要部構成を示す模式図である。
【図２】電圧印加時における上記液晶表示装置の要部構成を示す模式図である。
【図３】上記液晶表示装置の液晶セルの構成例を示すものであり、画素電極を示す斜視図である。
【図４】上記液晶セルの画素電極近傍を示すα－α線矢視断面図である。
【図５】上記液晶セルの他の構成例を示すものであり、画素電極を示す平面図である。
【図６】上記液晶表示装置を示すものであり、電圧無印加時の液晶分子の配向状態と、λ／４板の遅相軸と、偏光板の透過軸との関係を示す説明図である。
【図７】上記液晶表示装置を示すものであり、電圧印加時の液晶分子の配向状態と、λ／４板の遅相軸と、偏光板の透過軸との関係を示す説明図である。
【図８】上記液晶表示装置の表示例を示す説明図である。
【図９】上記液晶表示装置の透過強度と、従来の液晶表示装置の透過強度とを示すグラフである。
【図１０】λ／４板のリターデーションと透過率との関係を示すグラフである。
【図１１】上記液晶表示装置の変形例を示すものであり、λ／４板の遅相軸と、偏光板の透過軸との関係を示す説明図である。
【図１２】上記液晶表示装置の変形例を示すものであり、液晶表示装置の要部構成を示す模式図である。
【図１３】上記液晶セルのさらに他の構成例を示すものであり、画素電極を示す斜視図である。
【図１４】上記液晶セルのまた別の構成例を示すものであり、画素電極を示す斜視図である。
【図１５】上記液晶セルの他の構成例を示すものであり、画素電極近傍を示す平面図である。
【図１６】上記液晶セルのさらに他の構成例を示すものであり、画素電極近傍を示す平面図である。
【図１７】本発明の他の実施形態を示すものであり、液晶表示装置の要部構成を示す模式図である。
【図１８】従来例を示すものであり、液晶表示装置の要部構成を示す模式図である。
【図１９】上記液晶表示装置の表示例を示す説明図である。
【符号の説明】
１・１ａ～１ｇ　液晶表示装置
２１ａ　ＴＦＴ基板（第１基板）
２１ｂ　対向基板（第２基板）
３１　画素電極
２１ｃ　液晶層
２２ａ　偏光板（偏光子；円偏光手段）
２２ｂ　偏光板（検光子）
２３ａ　λ／４板（第２位相差層；円偏光手段）
２３ｂ　λ／４板（第１位相差層）
２４　視角補償板（視角補償層）
２５　選択反射層（円偏光手段）

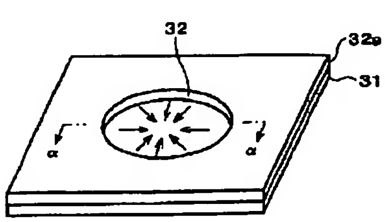
【図１】



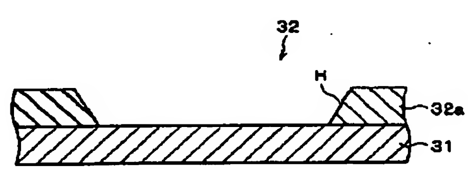
【図２】



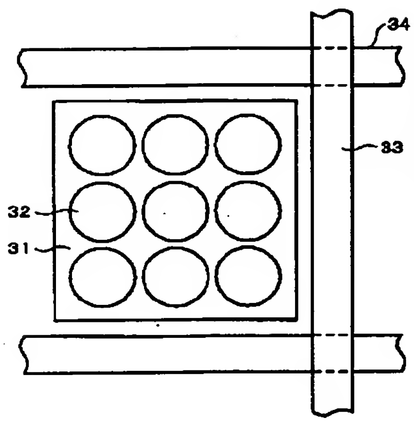
【図３】



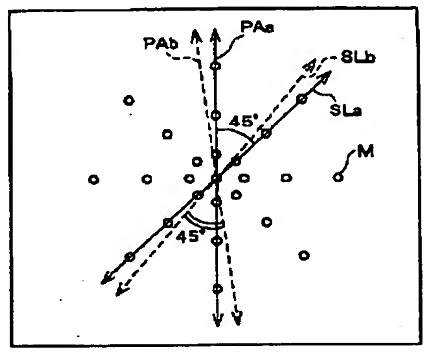
【図４】



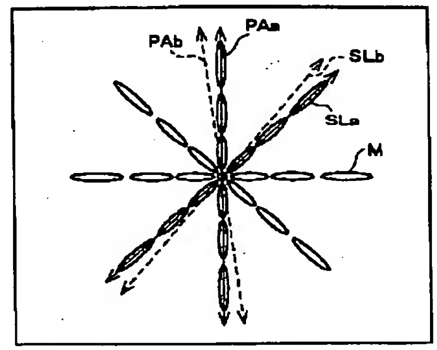
【図5】



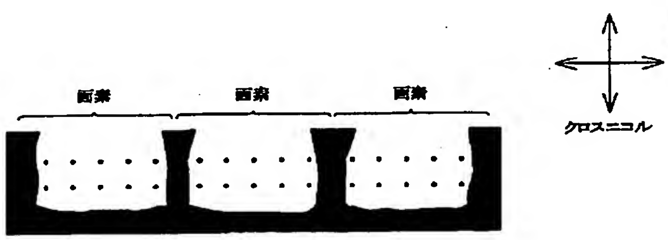
【図6】



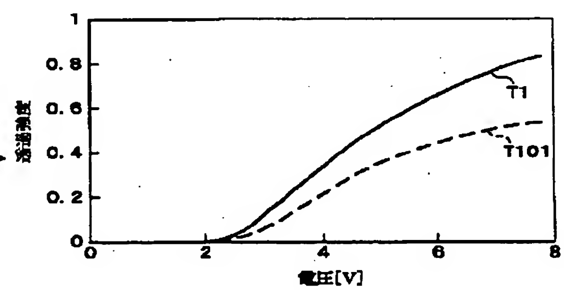
【図7】



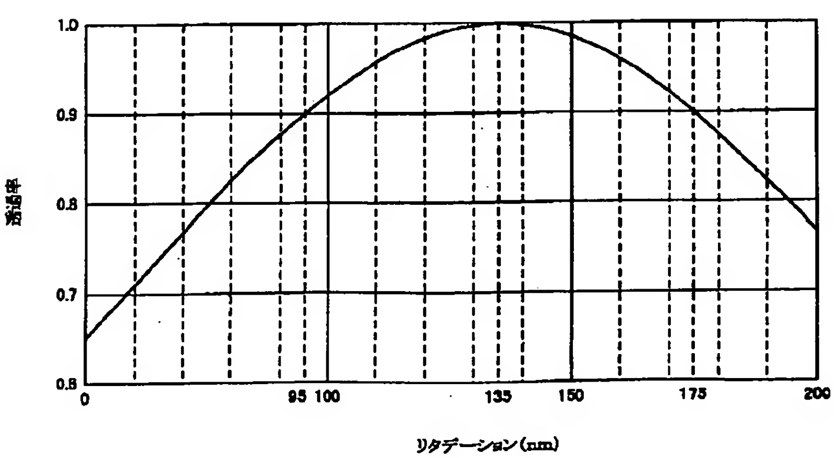
【図8】



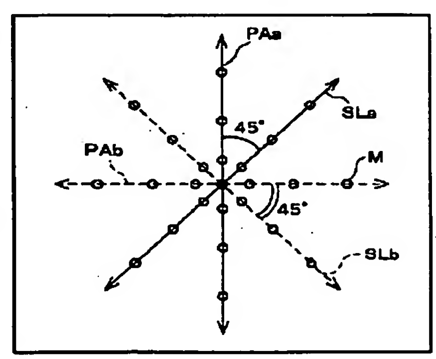
【図9】



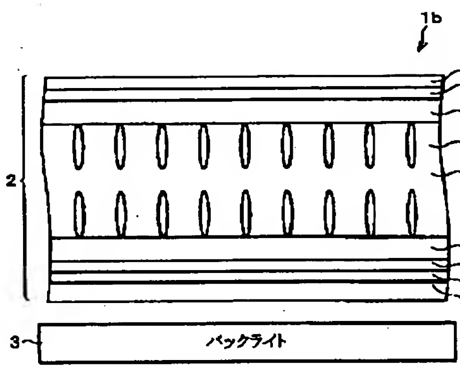
【図10】



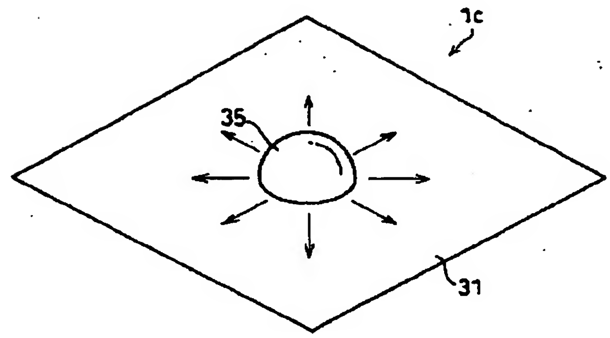
【図11】



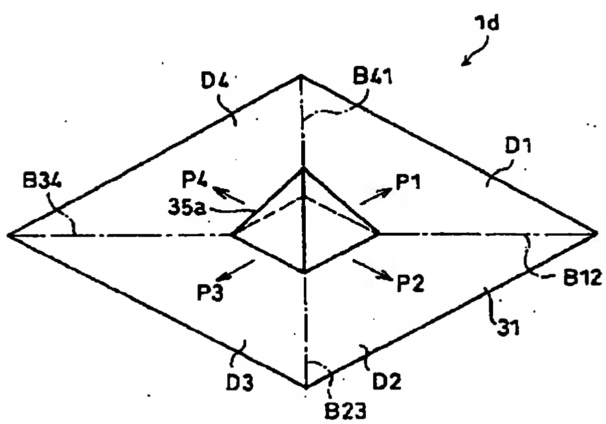
【図１２】



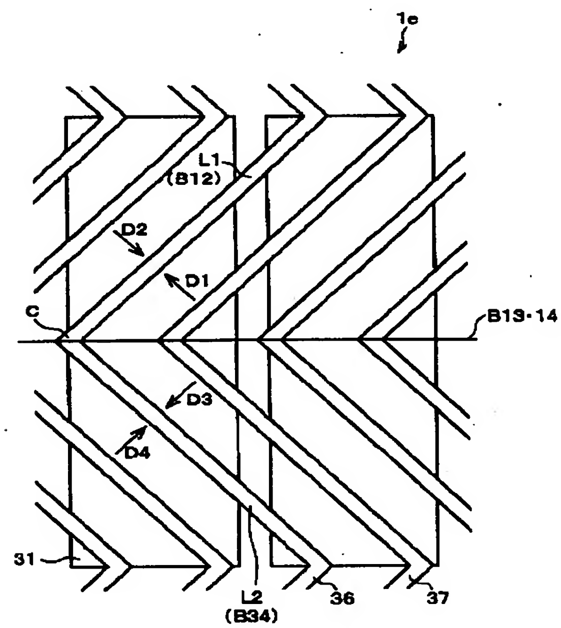
【図１３】



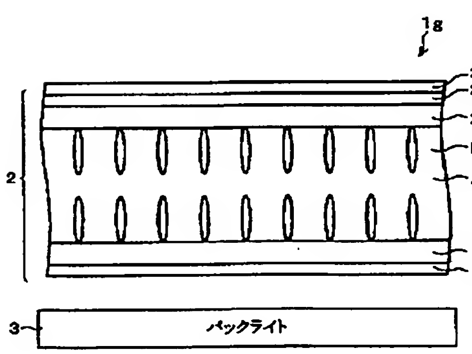
【図１４】



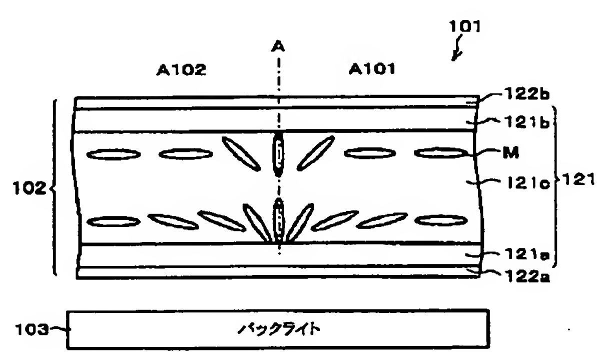
【図１５】



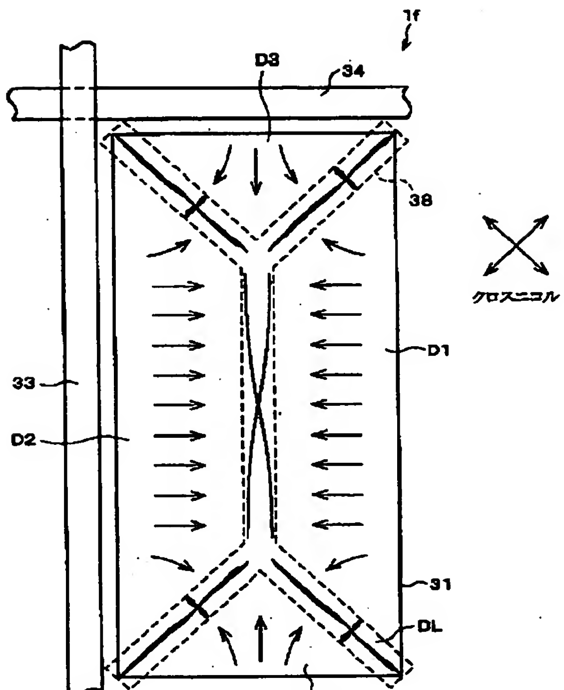
【図１７】



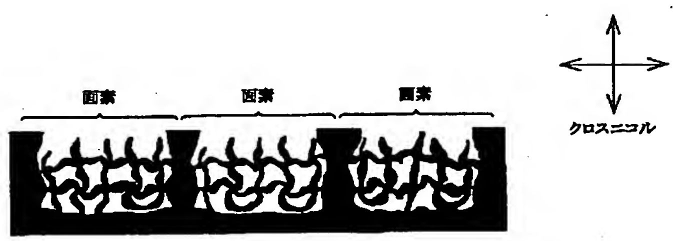
【図１８】



【図１６】



【図１９】



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LA16 LA20
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